PREPARED FOR
**SANTA CLARA VALLEY
WATER DISTRICT**

Conceptual Design Report

MUSSEL CONTROL MEASURES FOR IMPORTED WATER INTAKE PROJECT
AGREEMENT # A3369A, PROJECT NO. 91452011

FINAL REPORT
JULY 2011

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BUILDING A BETTER WORLD

RNT CONSULTING INC

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Executive Summary

The Santa Clara Valley Water District (District, SCVWD) wishes to protect its raw water systems from zebra and quagga mussels (dreissenid mussels) in the event that they become established in the District's imported source water. These non-native, invasive mussels are an environmental and economic nuisance, with the potential to harm ecosystems, affect water system reliability, damage equipment and infrastructure, and require significant investment to control. For the District, infestation of invasive freshwater mussels in source water could result in reduced flows through intake and piping systems, increased energy use to pump water through clogged lines, damage to or impairment of water conveyance equipment, and taste and odor problems for delivered water if these negative impacts are not mitigated.

As part of the Invasive Mussel Control Measures at Imported Water Intakes project, the MWH-RNT team has prepared a technical memorandum on the vulnerability of the District's imported water facilities (RNT, 2010) and the Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities (MWH, 2011). This report presents conceptual designs for full-barrier and partial-protection strategies for the South Bay Aqueduct (SBA) and San Luis Reservoir (SLR) systems, including design criteria, process flow diagrams, site layouts, process cross-sections, estimates of impacts to system hydraulics, and preliminary estimates of project costs at the 10 percent design level. The purpose of this planning-level document is to provide District staff with information that is critical to the decision-making process at this stage of the project.

Full-Barrier Strategy for the SBA System

The Full-Barrier Strategy for the SBA System involves chlorine dioxide addition to kill mussel larvae and mechanical filters to remove translocating juvenile and adult mussels. The facilities would be located near the Santa Clara Meter Vault, with dechlorination facilities at Piedmont Valve Yard and between the SBA Terminal Tank and the percolation pond area.

Chlorine dioxide will be manufactured on-site from sodium chlorite, sodium hypochlorite, and hydrochloric acid. The assumed chlorine dioxide dose is 1.4 mg/L, the maximum dose that can be added without risking formation of chlorite at concentrations above its maximum contaminant level (MCL). Bench scale testing is recommended to confirm the demand and decay and pilot testing is recommended to confirm the dose needed to inactivate 100 percent of the mussel larvae that will pass through the mechanical filters.

A chemical storage building will be constructed to house the chemical tanks and chlorine dioxide generator. Tanks have been sized to store chemicals for 14 days at maximum usage.

Tees will be installed in the existing 72-inch pipe to divert water through a set of seven mechanical filters operating in parallel. Header pipes (72-inch diameter) to and from the entire filter system will be buried. Pipes (36-inch and 28-inch diameter) to and from each filter will be above ground, with a concrete pad below the filter area.

Two butterfly valves will be installed in the existing 72-inch pipe between the tees to allow the filters to be bypassed, if needed. A 12-inch nozzle, open to the atmosphere, will be installed between the tees to monitor for valve leakage and provide assurance that no water bypasses the filters. During filter operation, the valves will be closed. The valves may be opened after capping the nozzle, if a filter bypass is ever needed. A vault will be constructed to allow access to the valves and to inspect for valve leakage.

Estimate of Total Project Cost for the Full-Barrier Strategy for the SBA System

Table ES-1 presents an estimate of total project life cycle costs for the Full-Barrier Strategy for the SBA System.

Table ES-1. Estimated Total Project Life Cycle Costs for the Full-Barrier Strategy for the SBA System

Capital Costs	$12,277,000
Annual O&M Costs	$2,310,000
25-Year Present Worth Life Cycle Cost (R=5%)	$32,557,000
Total Project Cost (25-Year Present Worth)	**$45,000,000**

Key:
R = Net interest rate
Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

Full-Barrier Strategy for the SLR System

The Full-Barrier Strategy for the SLR System involves chlorine dioxide addition to kill mussel larvae and mechanical filters to remove translocating juvenile and adult mussels. The facilities would be located at the Pacheco Pump Plant, with chlorine dioxide addition in Pacheco Tunnel Reach 1, immediately downstream of the upper intake. Dechlorination facilities would be located at the Hollister Bifurcation Structure.

Chlorine dioxide will be manufactured on-site from sodium chlorite, sodium hypochlorite, and hydrochloric acid. The assumed chlorine dioxide dose is 1.4 mg/L, the maximum dose that can be added without risking formation of chlorite at concentrations above its MCL. Bench scale testing is recommended to confirm the demand and decay and pilot testing is recommended to confirm the dose needed to inactivate 100 percent of the mussel larvae that will pass through the mechanical filters.

A chemical storage building will be constructed to house the chemical tanks and chlorine dioxide generator. Tanks have been sized to store chemicals for 14 days at maximum usage.

Tees will be installed in the existing 120-inch pipe to divert water through a set of 18 mechanical filters operating in parallel. Header pipes (120-inch diameter) to and from the entire filter system will be buried. Pipes (36-inch and 28-inch diameter) to and from each filter will be above ground, with a concrete pad below the filter area.

Two butterfly valves will be installed in the existing 120-inch pipe between the tees to allow the filters to be bypassed, if needed. A 12-inch nozzle, open to the atmosphere, will be installed between the tees to monitor for valve leakage and provide assurance that no water bypasses the filters. During filter operation, the valves will be closed. The valves may be opened after capping the nozzle, if a filter bypass is ever needed. A vault will be constructed to allow access to the valves and to inspect for valve leakage.

Estimate of Total Project Cost for the Full-Barrier Strategy for the SLR System

Table ES-2 presents an estimate of total project life cycle costs for the Full-Barrier Strategy for the SLR System.

Table ES-2. Estimated Total Project Life Cycle Costs for the Full-Barrier Strategy for the SLR System

Capital Costs	**$30,309,000**
Annual O&M Costs	$3,375,000
25-Year Present Worth Life Cycle Cost (R=5%)	$47,567,000
Total Project Cost (25-Year Present Worth)	**$78,000,000**

Key:
R = Net interest rate
Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

Partial-Protection Strategy

The Partial-Protection Strategy for the SBA and SLR systems involves potassium chloride addition for a 52-day period each year to protect large portions of the raw water system downstream of the injection point. This strategy is considered to be partially-protective in that it does not protect reservoirs and other water bodies that receive water from the raw water system, and it is not intended to be operated continuously. It would be applied on a regular basis as a maintenance practice for vulnerable equipment and other segments of the raw water system. This system could provide a secondary benefit because it offers some mitigation should mussels get into the system downstream of the Full-Barrier Strategy. Potassium would be much more persistent in the raw water system than chlorine dioxide, making it more effective further downstream for killing settled mussels in the raw water infrastructure.

The assumed potassium dose is 20 mg/L. To reduce the size of the system and annual O&M costs, it is assumed that the potassium addition will occur between the beginning of November and the end of February, when imported water deliveries are typically low.

Partial-Protection Strategy for the SBA System

Two silos would be provided at the Santa Clara Meter Vault property for storage of soluble potassium chloride and to contain the mix and feed tanks. The silos will be approximately 28 feet tall and 12 feet in diameter. The silos have been sized to store soluble muriate of potash for 7 days at 136 cubic feet per second (cfs). The bottom of the storage cone will be approximately 16.5 feet above the finished floor to accommodate the screw feeder, mix tank, and feed tank. Stainless steel materials are assumed for the silos, mix tanks, feed tanks, and pipes conveying dry chemicals.

Batches of 25 percent potassium chloride solution will be made in a mix tank from the soluble muriate of potash and on-site chemical carrier water. Upon completion, the batch will be released and flow by gravity to a larger feed tank. Each set of mix and feed tanks have been sized to adequately meet the design capacity. Thus, one silo system (consisting of dry storage, mix tank, and feed tank) could be operated until the chemical storage reaches a minimum value, at which point operations would switch to the other silo system.

Four diaphragm metering pumps will pull from the feed tanks. PVC piping will deliver the solution to an inline mixer installed in the SBA pipeline.

Estimate of Total Project Cost for the Partial-Protection Strategy for the SBA System

Table ES-3 presents an estimate of total project life cycle costs for the Partial-Protection Strategy for the SBA System.

Table ES-3. Estimated Total Project Life Cycle Costs for the Partial-Protection Strategy for the SBA System

Capital Costs	$2,037,000
Annual O&M Costs	$362,000
5-Year Present Worth Life Cycle Cost (R=5%)	$1,567,000
Total Project Cost (5-Year Present Worth)	**$3,604,000**

Key:
R = Net interest rate
Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

Partial-Protection Strategy for the SLR System

Two silos would be provided at the Pacheco Pump Plant for storage of soluble potassium chloride and to contain the mix and feed tanks. The silos will be approximately 34 feet tall and 12 feet in diameter. The silos have been sized to store soluble muriate of potash for 7 days at 180 cfs. The bottom of the storage cone will be approximately 19 feet above the finished floor to accommodate the screw feeder, mix tank, and feed tank. Stainless steel materials are assumed for the silos, mix tanks, feed tanks, and pipes conveying dry chemicals.

Batches of 25 percent potassium chloride solution will be made in a mix tank from the soluble muriate of potash and on-site chemical carrier water. Upon completion, the batch will be released and flow by gravity to a larger feed tank. Each set of mix and feed tanks have been sized to adequately meet the design capacity. Thus, one silo system (consisting of dry storage, mix tank, and feed tank) could be operated until the chemical storage reaches a minimum value, at which point operations would switch to the other silo system.

Four diaphragm metering pumps will pull from the feed tanks. PVC piping will deliver the solution to the surge shaft, where the pipe will connect to a spare pipe to be installed as part of the chlorine dioxide system.

Estimate of Total Project Cost for the Partial-Protection Strategy for the SLR System

Table ES-4 presents an estimate of total project life cycle costs for the Partial-Protection Strategy for the SLR System.

Table ES-4. Estimated Total Project Life Cycle Costs for the Partial-Protection Strategy for the SLR System

Capital Costs	$2,314,000
Annual O&M Costs	$537,000
5-Year Present Worth Life Cycle Cost (R=5%)	$2,325,000
Total Project Cost (5-Year Present Worth)	**$4,639,000**

Key:
R = Net interest rate
Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

SLR Intake Trash Racks

The trash racks on the San Luis Reservoir intakes need to be protected from settlement by dreissenid mussels and, because they are upstream of any chemical injection, they will not be protected by the Full-Barrier or Partial-Protection strategies.

The existing trash racks are removable, and at least one was removed, inspected, and cleaned in September 2008. There is stainless steel screen mesh that was bolted to the outside of the trash racks at some point after original installation.

It is recommended that new trash racks with a biofouling-resistant coating be installed. The new trash racks should be designed with the same dimensions as the existing racks in order to install and remove them easily. The frame and horizontal supports should match the existing racks. While the original vertical bar spacing of 6 inches would be ideal for a mussel-resistant trash rack design, we assume that the mesh screen was installed to protect the Pacheco Tunnel and pumps at the Pacheco Pump Plant from debris that could enter the intake. To minimize flow constriction that could be caused if mussels settle on the trash racks, we recommend discontinuing use of the mesh screen and that the racks be designed with the widest acceptable spacing, up to 6 inches. The trash racks should be designed with lifting eyes to assist in removal.

For the purposes of the cost estimate in this section, we assume that the 0.625-inch vertical bars will be spaced 3 inches apart to achieve a clear opening of approximately 2.375 inches. Additionally, the entire trash rack should have a silicone-based foul-release coating. For the purposes of the cost estimate in this section, we assume that the coating system will include 2 coats of an epoxy primer (3 to 6 millimeters thick per coat) followed by a top coat of Intersleek 970 silicone coating (5 to 8 millimeters thick).

It is also recommended that the existing trash racks be retrofitted to match the new trash racks (i.e., matching vertical bar spacing, a silicone coating, lifting eyes, and removal of the mesh screen that is currently attached). Following the retrofit, use of the new and existing trash racks could be rotated to allow for more efficient and safer inspection and cleaning at the surface, without lengthy disruptions to operation of the intakes.

The SLR intake trash rack replacement/modification costs (including equipment, installation, and other capital costs) are estimated at approximately $1 million.

Next Steps

A list of some of the next steps needed to advance the Invasive Mussel Control Measures at Imported Water Intakes Project is provided below:

- Bench scale testing of chlorine dioxide demand and decay in imported source water
- Pilot testing of the Full-Barrier and Partial-Protection strategies
- Developing estimates of costs incurred under minimal or no protection scenarios for cost comparison and decision-making purposes
- Detailed design of the Full-Barrier Strategy
- Design and construction of the Partial-Protection Strategy
- Coordination with regulatory agencies

Contents

Page

1.0 Introduction 1-1
1.1 Summary of Feasibility Study 1-1
1.1.1 Protection/Mitigation Strategies and Alternatives 1-1
1.1.2 Recommended Protection Strategies 1-2
1.2 Purpose of Report 1-3

2.0 Full-Barrier Strategy for the SBA System 2-1
2.1 Conceptual Design for the Full-Barrier Strategy for the SBA System 2-1
2.1.1 Hydraulic Considerations 2-11
2.1.2 Backwash and Solids Handling 2-11
2.1.3 Removal of Chlorine Dioxide Residual 2-12
2.2 Cost Estimate for the Full-Barrier Strategy for the SBA System 2-17
2.2.1 Opinion of Probable Construction Costs 2-17
2.2.2 Estimate of Annual O&M Costs 2-18
2.2.3 Estimate of Total Project Cost 2-19

3.0 Full-Barrier Strategy for the SLR System 3-1
3.1 Conceptual Design for the Full-Barrier Strategy for the SLR System 3-1
3.1.1 Hydraulic Considerations 3-13
3.1.2 Backwash and Solids Handling 3-13
3.1.3 Removal of Chlorine Dioxide Residual 3-14
3.2 Cost Estimate for the Full-Barrier Strategy for the SLR System 3-17
3.2.1 Opinion of Probable Construction Costs 3-17
3.2.2 Estimate of Annual O&M Costs 3-18
3.2.3 Estimate of Total Project Cost 3-18

4.0 Partial-Protection Strategy for the SBA System 4-1
4.1 Conceptual Design for the Partial-Protection Strategy for the SBA System 4-1
4.2 Cost Estimate for the Partial-Protection Strategy for the SBA System 4-7
4.2.1 Opinion of Probable Construction Costs 4-7
4.2.2 Estimate of Annual O&M Costs 4-7
4.2.3 Estimate of Total Project Cost 4-8

5.0 Partial-Protection Strategy for the SLR System 5-1
5.1 Conceptual Design for the Partial-Protection Strategy for the SLR System 5-1
5.2 Cost Estimate for the Partial-Protection Strategy for the SLR System 5-9
5.2.1 Opinion of Probable Construction Costs 5-9
5.2.2 Estimate of Annual O&M Costs 5-9
5.2.3 Estimate of Total Project Cost 5-10

6.0 SLR Intake Trash Racks 6-1

7.0 Next Steps 7-1
7.1 Continue Proactive Measures 7-1
7.2 Bench Scale Testing 7-1
7.3 Pilot Testing 7-1
7.4 Develop Estimates of Costs Incurred Under Minimal or No Protection Scenarios 7-2
7.5 Detailed Design of the Full-Barrier Strategy 7-2
7.6 Design and Construction of the Partial-Protection Strategy 7-2
7.7 Coordination with Regulatory Agencies 7-2

8.0 References 8-1

Tables

Table 2-1. Preliminary Design Criteria for the Full-Barrier Strategy for the SBA System........ 2-9
Table 2-2. OPCC Summary for the Full-Barrier Strategy for the SBA System....................... 2-17
Table 2-3. Estimate of Annual O&M Costs for the Full-Barrier Strategy for the SBA System2-18
Table 2-4. Estimated Total Project Life Cycle Costs for the Full-Barrier Strategy for the SBA System... 2-19
Table 3-1. Preliminary Design Criteria for the Full-Barrier Strategy for the SLR System...... 3-11
Table 3-2. OPCC Summary for the Full-Barrier Strategy for the SLR System 3-17
Table 3-3. Estimate of Annual O&M Costs for the Full-Barrier Strategy for the SLR System3-18
Table 3-4. Estimated Total Project Life Cycle Costs for the Full-Barrier Strategy for the SLR System... 3-18
Table 4-1. Preliminary Design Criteria for the Partial-Protection Strategy for the SBA System4-6
Table 4-2. OPCC Summary for the Partial-Protection Strategy for the SBA System................ 4-7
Table 4-3. Estimate of Annual O&M Costs for the Partial-Protection Strategy for the SBA System... 4-8
Table 4-4. Estimated Total Project Life Cycle Costs for the Partial-Protection Strategy for the SBA System.. 4-8
Table 5-1. Preliminary Design Criteria for the Partial-Protection Strategy for the SLR System5-8
Table 5-2. OPCC Summary for the Partial-Protection Strategy for the SLR System 5-9
Table 5-3. Estimate of Annual O&M Costs for the Partial-Protection Strategy for the SLR System... 5-10
Table 5-4. Estimated Total Project Life Cycle Costs for the Partial-Protection Strategy for the SLR System 5-10
Table 6-1. OPCC Summary for Replacement and Modifications to the SLR Intake Trash Racks6-3

Figures

Figure 2-1. Process Flow Diagram for Full-Barrier Strategy for the SBA System.................... 2-3
Figure 2-2. Site Layout for Full-Barrier Strategy near the Santa Clara Meter Vault 2-5
Figure 2-3. Section View of Mechanical Filter and Piping near the Santa Clara Meter Vault .. 2-7
Figure 2-4. Site Layout for Dechlorination at the Piedmont Valve Yard................................ 2-13
Figure 2-5. Site Layout for Dechlorination after the SBA Terminal Tank.............................. 2-15
Figure 3-1. Process Flow Diagram for Full-Barrier Strategy for the SLR System.................... 3-3
Figure 3-2. Site Layout for Full-Barrier Strategy at the Pacheco Pump Plant 3-5
Figure 3-3. Section View of the Mechanical Filter and Piping at the Pacheco Pump Plant....... 3-7
Figure 3-4. Section View of Chemical Injection in Pacheco Tunnel Reach 1 3-9
Figure 3-5. Site Layout for Dechlorination at the Hollister Bifurcation.................................. 3-15
Figure 4-1. Process Flow Diagram for Partial-Protection Strategy for the SBA System........... 4-2
Figure 4-2. Site Layout for Partial-Protection Strategy near the Santa Clara Meter Vault 4-4
Figure 5-1. Process Flow Diagram for Partial-Protection Strategy for the SLR System 5-2
Figure 5-2. Site Layout for Partial-Protection Strategy at the Pacheco Pump Plant 5-4
Figure 5-3. Section View of Chemical Injection in Pacheco Tunnel Reach 1 5-6

Photographs

Photograph 6-1. Trash Rack Temporarily Removed from the Upper Intake in 2008 6-1

Appendices

Appendix A.	Dupont Chlorine Dioxide Generation Equipment Proposal
Appendix B.	Hydac RF3 Automatic Self-Cleaning Filters
Appendix C.	Hydraulics Calculations for the Full-Barrier Strategy for the SBA System
Appendix D.	Laboratory Report for Water Samples Collected on March 16, 2011
Appendix E.	Parkson Lamella Gravity Settler
Appendix F.	OPCC for the Full-Barrier Strategy for the SBA System
Appendix G.	Hydraulics Calculations for the Full-Barrier Strategy for the SLR System
Appendix H.	OPCC for the Full-Barrier Strategy for the SLR System
Appendix I.	Reclamation Plan Drawings of Pacheco Inlet Intakes and Trash Racks

Abbreviations and Acronyms

µm	micron
cfs	cubic feet per second
cm	centimeter
District	Santa Clara Valley Water District
FTE	full time equivalent
Full-Barrier Strategy	Long-Term, Full-Barrier Protection Strategy
gmp	gallons per minute
MCL	maximum contaminant level
mg/L	milligrams per liter
mm	millimeter
NTU	nephelometric turbidity units
O&M	operations and maintenance
OPCC	opinion of probable construction costs
ppm	parts per million
PSD	particle size distribution
psi	pounds per square inch
PVC	polyvinyl chloride
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
SBA	South Bay Aqueduct
SCVWD	Santa Clara Valley Water District
SLR	San Luis Reservoir
TSS	total suspended solid
UV	ultraviolet

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1.0 Introduction

The Santa Clara Valley Water District (District, SCVWD) wishes to protect its raw water systems from zebra and quagga mussels (dreissenid mussels) in the event that they become established in the District's imported source water. These non-native, invasive mussels are an environmental and economic nuisance, with the potential to harm ecosystems, affect water system reliability, damage equipment and infrastructure, and require significant investment to control. For the District, infestation of invasive freshwater mussels in source water could result in reduced flows through intake and piping systems, increased energy use to pump water through clogged lines, damage to or impairment of water conveyance equipment, and taste and odor problems for delivered water if these negative impacts are not mitigated.

The District is already taking proactive measures to keep invasive mussels out of its reservoirs with boating inspections on four reservoirs and closure of boating on others except by special permit (i.e., rowing club, ski club, etc.). The District has conducted mussel vulnerability assessments of three pumping plants, local reservoirs, and water treatment plants. The District has also implemented regular mussel monitoring and has developed an invasive mussel response plan. As part of the Invasive Mussel Control Measures at Imported Water Intakes project, the MWH-RNT team has prepared a technical memorandum on the vulnerability of the District's imported water facilities (RNT, 2010) and the Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities (MWH, 2011).

1.1 Summary of Feasibility Study

The Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities (MWH, 2011):

- Identified and evaluated a comprehensive list of control methods for their ability to meet the District's protection objectives.
- Narrowed the list of control methods through a fatal flaw analysis and proposed protection strategy alternatives to be considered further.
- Developed basic design criteria and order-of-magnitude cost estimates for each protection strategy alternative.
- Ranked the alternatives through a weighted scoring process and recommended the best alternative to be carried forward for conceptual design.

1.1.1 Protection/Mitigation Strategies and Alternatives

Protection strategies should maintain (or minimize impact to) District raw water operations and water treatment facilities. Strategies for protecting District equipment and resources from invasive mussels, or mitigating the impacts caused by mussels, were grouped into three categories:

- Long-Term, Full-Barrier Protection Strategy (Full-Barrier Strategy) Alternatives
- Short-Term, Partial-System Protection Strategy (Partial-Protection Strategy) Alternatives
- Reactive Mitigation

Full-Barrier Strategy Alternatives involve a combination of mechanical filtration with chemical addition or ultraviolet (UV) irradiation for a multi-barrier approach. The mechanical filtration component is for control of adult and juvenile mussels, and the chemical addition or UV irradiation is intended to kill or damage mussel larvae to prevent establishment of mussel populations downstream and outside of the influence of the protection strategy.

The Full-Barrier Strategy would be implemented in an attempt to prevent any viable mussels from passing beyond a designated control location (e.g., Santa Clara Flow Meter Vault or Pacheco Pump Plant) within the raw water system. Meeting this objective would be protective of the downstream raw water system and receiving surface waters. It is important to note that 100 percent protection of the downstream system and receiving waters has never been attempted by a large water utility. The closest analogues are ballast water protection systems currently being tested. Mussel control methods have traditionally been implemented by utilities in response to infestations of mussels in their source water or system and have been designed to minimize the growth of mussels and/or mitigate the effects of mussels once they enter their system.

Full-Barrier Strategy Alternatives are very expensive and will require significant lead time to implement (estimated at 3 to 6 years). Consequently, Partial-Protection Strategy Alternatives that could be implemented in less than 3 years have also been evaluated. These alternatives involve pH adjustment or addition of chlorine or potassium to prevent settlement of mussels in protected segments of the system, and some elements of the Partial-Protection Strategy may be compatible with the Full-Barrier Alternatives.

Because the Partial-Protection Strategies do not involve filtration, they are less protective than the Full-Barrier Strategies, as translocating juveniles and adults would likely survive the chemical treatments and could reach areas that are not protected. Some of the Partial-Protection Strategies may also have greater impacts to water quality or the environment than the Full-Barrier Strategies. Despite these drawbacks, they represent an improvement over the existing system in terms of protection from invasive mussels and minimization of impacts.

Reactive mitigation should be considered if mussels become established in the District system downstream of the designated control locations. It would consist of periodic treatments to reduce the populations of settled adults within the raw water system or reservoirs. Although it would not prevent mussels from entering the system and potentially settling in pipelines or local reservoirs, it may be part of a program to successfully maintain District raw water operations and to minimize impact to District water treatment facilities.

1.1.2 Recommended Protection Strategies

Full-Barrier Alternative 3, Mechanical Filters and Chlorine Dioxide, is the recommended Full-Barrier Strategy for both the South Bay Aqueduct (SBA) System and San Luis Reservoir (SLR)

System. This recommendation is dependent on future bench scale and pilot scale testing to confirm that chlorine dioxide can meet the District's objectives without producing unacceptable levels of disinfection by-products. Alternative 2, Mechanical Filters and Ferrate, was ranked second highest, and should be considered if chlorine dioxide proves unable to meet the District's objectives. Like chlorine dioxide, pilot testing is needed to establish the required ferrate dose.

Partial-Protection Alternative 3b, Periodic Potassium Feed, is the recommended Partial-Protection Strategy for both the SBA and SLR systems.

The trash racks on the San Luis Reservoir intakes need to be protected from settlement by dreissenid mussels and, because they are upstream of the designated control points, they will not be protected by the Full-Barrier or Partial-Protection strategies. It is recommended that new trash racks, with a biofouling-resistant coating and vertical bars instead of a bar grid, be installed. Protection of the trash racks could be maximized by having removable racks and spares. Having more than one removable rack per intake would allow for more efficient and safer cleaning at the surface.

1.2 Purpose of Report

This report presents conceptual designs for the recommended Full-Barrier and Partial-Protection strategies for the SBA and SLR systems, including design criteria, process flow diagrams, site layouts, process cross-sections, estimates of impacts to system hydraulics, and preliminary estimates of project costs at the 10 percent design level. The purpose of this planning-level document is to provide District staff with information that is critical to the decision-making process at this stage of the project.

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2.0 Full-Barrier Strategy for the SBA System

As identified in the Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities (MWH, 2011), mechanical filters and chlorine dioxide addition were recommended as the Full-Barrier Strategy for the SBA System.

2.1 Conceptual Design for the Full-Barrier Strategy for the SBA System

A process flow diagram for the Full-Barrier Strategy for the SBA System is provided as Figure 2-1. Figure 2-2 shows the site layout for the Full-Barrier Strategy near the Santa Clara Meter Vault. Figure 2-3 shows a section view of a mechanical filter and piping for the SBA system.

Preliminary design criteria for the Full-Barrier Strategy for the SBA System are presented in Table 2-1.

Chlorine dioxide will be manufactured on-site from sodium chlorite, sodium hypochlorite, and hydrochloric acid. A proposal from Dupont for a chlorine dioxide generator is included as Appendix A. A 3,000-parts-per-million (ppm) chlorine dioxide solution will be injected through a diffuser immediately after water is withdrawn from the SBA. The assumed chlorine dioxide dose is 1.4 milligrams per liter (mg/L), the maximum dose that can be added without risking formation of chlorite at concentrations above its maximum contaminant level (MCL). Bench scale testing is recommended to confirm the demand and decay and pilot testing is recommended to confirm the dose needed to inactivate 100 percent of the mussel larvae that will pass through the mechanical filters.

A chemical storage building will be constructed to house the chemical tanks and chlorine dioxide generator. Tanks have been sized to store chemicals for 14 days at maximum usage.

Tees will be installed in the existing 72-inch pipe to divert water through a set of seven mechanical filters operating in parallel. Header pipes (72-inch diameter) to and from the entire filter system will be buried. Pipes (36-inch and 28-inch in diameter) to and from each filter will be above ground, with a concrete pad below the filter area.

The design criteria, site layouts, and cost estimates in this report use Hydac filters to minimize the overall system footprint (7 Hydac filters instead of 8 Amiad filters with a 13 percent larger diameter per filter). Hydac, Amiad, and other filter manufacturers should be contacted during detailed design and the advantages and disadvantages of each make and model should be carefully considered to assist in the selection of the best system to meet the District’s objectives. Information about Hydac RF3 automatic self-cleaning filters is included as Appendix B.

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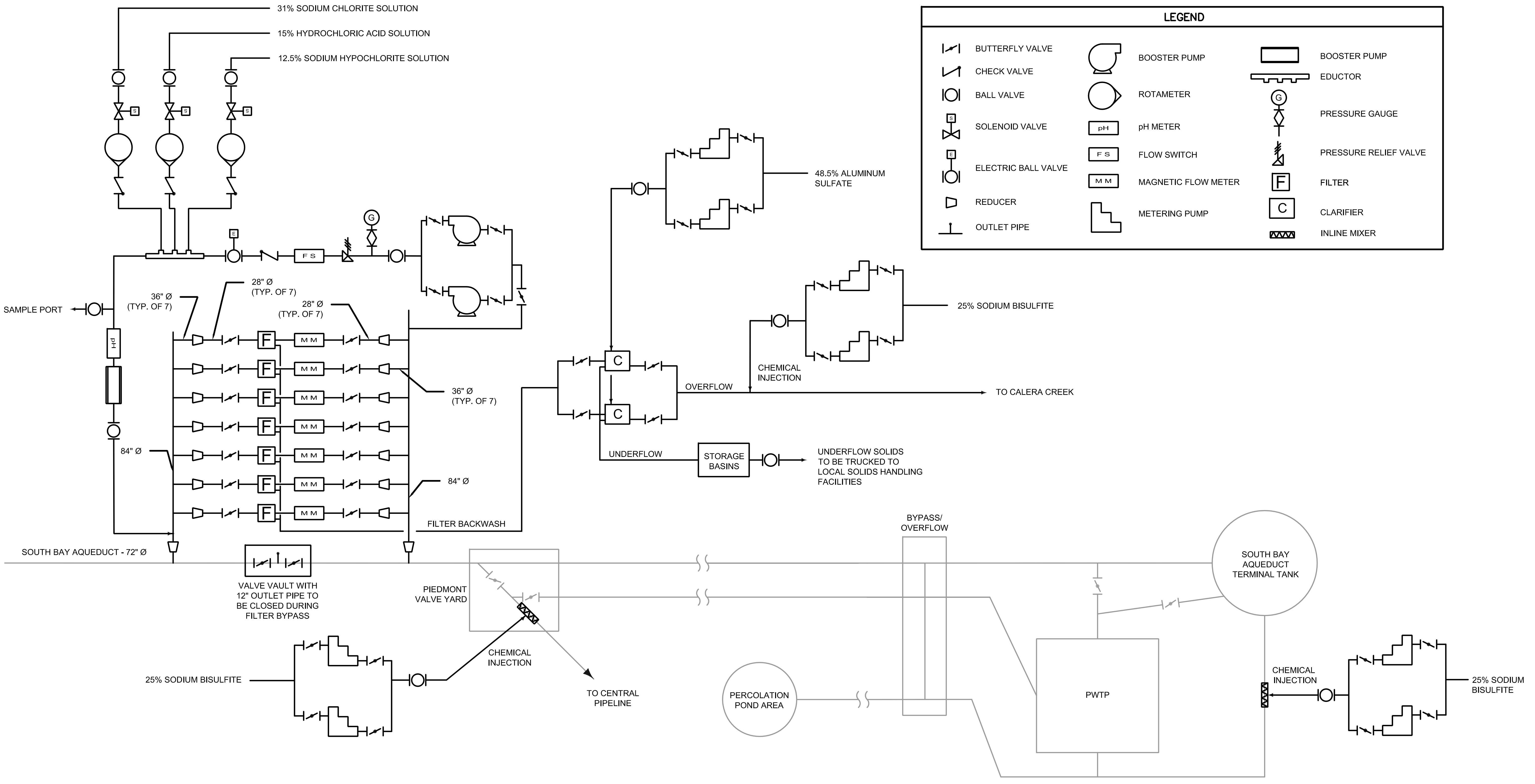

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MWH

Santa Clara Valley Water District

PROCESS FLOW DIAGRAM FOR FULL-BARRIER STRATEGY FOR THE SBA SYSTEM

SCALE
NO SCALE

JOB NO.

FIGURE 2–1

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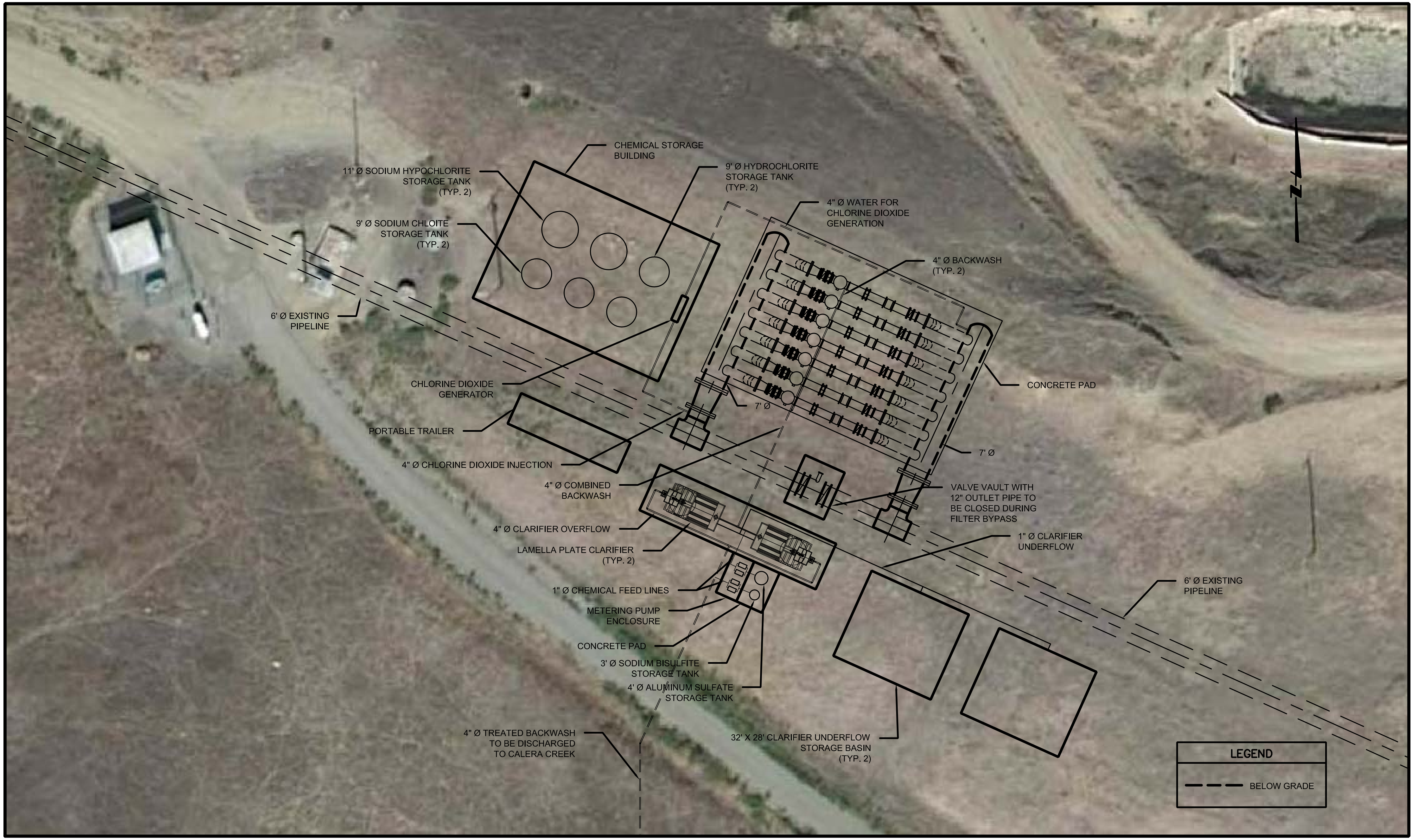
CHEMICAL STORAGE BUILDING
11' Ø SODIUM HYPOCHLORITE STORAGE TANK (TYP. 2)
9' Ø HYDROCHLORITE STORAGE TANK (TYP. 2)
9' Ø SODIUM CHLOITE STORAGE TANK (TYP. 2)
4" Ø WATER FOR CHLORINE DIOXIDE GENERATION
4" Ø BACKWASH (TYP. 2)
N
6' Ø EXISTING PIPELINE
CHLORINE DIOXIDE GENERATOR
CONCRETE PAD
7' Ø
PORTABLE TRAILER
7' Ø
4" Ø CHLORINE DIOXIDE INJECTION
4" Ø COMBINED BACKWASH
VALVE VAULT WITH 12" OUTLET PIPE TO BE CLOSED DURING FILTER BYPASS
4" Ø CLARIFIER OVERFLOW
1" Ø CLARIFIER UNDERFLOW
LAMELLA PLATE CLARIFIER (TYP. 2)
6' Ø EXISTING PIPELINE
1" Ø CHEMICAL FEED LINES
METERING PUMP ENCLOSURE
CONCRETE PAD
3' Ø SODIUM BISULFITE STORAGE TANK
4' Ø ALUMINUM SULFATE STORAGE TANK
4" Ø TREATED BACKWASH TO BE DISCHARGED TO CALERA CREEK
32' X 28' CLARIFIER UNDERFLOW STORAGE BASIN (TYP. 2)
LEGEND
BELOW GRADE

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Santa Clara Valley Water District

SITE LAYOUT FOR FULL-BARRIER STRATEGY NEAR THE SANTA CLARA METER VAULT

SCALE
1" = 30'

JOB NO.

FIGURE 2–2

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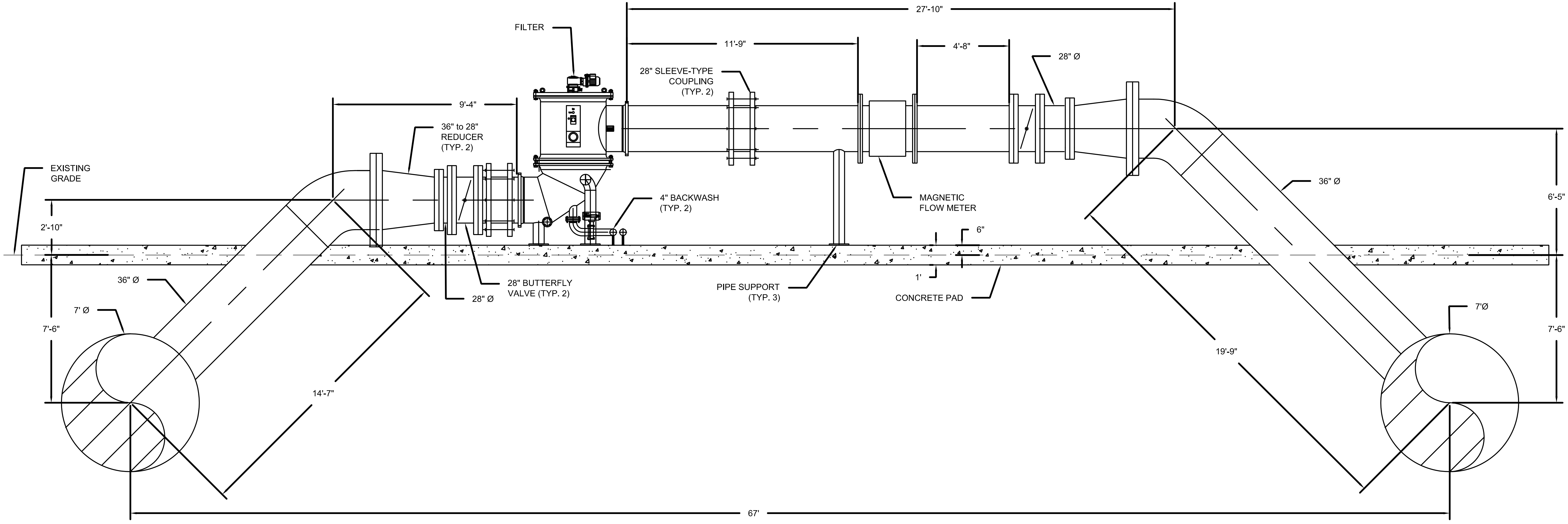

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Santa Clara Valley Water District

SECTION VIEW OF THE MECHANICAL FILTER AND
PIPING NEAR THE SANTA CLARA METER VAULT

SCALE
1" = 5'

JOB NO.

FIGURE 2–3

\\Uswck1netapp1\mss\Projects\SCVWD–Invasive Mussels\6.0 STUDIES & REPORTS\6.1 Reports\Task 4 Conceptual Design\Drawings\FIGX–XSEC–PPP–SBA.dwg May 24, 2011 – 5:51pm

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Table 2-1. Preliminary Design Criteria for the Full-Barrier Strategy for the SBA System

Description	Units	Criteria
SBA Flow at SCMV		
Maximum flow	cfs	185
Maximum flow	mgd	120
Typical flow	cfs	85
Typical flow	mgd	55
SBA Chlorine Dioxide Dose and Storage		
Assumed chlorine dioxide dose	mg/L	1.4
Type of chlorine dioxide generator system	--	3-chemical
Quantity of 31% $NaClO_2$ solution at maximum flow	lbs/day	6,067
Quantity of 12.5% NaOCl solution at maximum flow	lbs/day	6,936
Quantity of 15% HCl solution at maximum flow	lbs/day	5,044
Number of tanks for 31% $NaClO_2$ solution	No.	2
Volume of each tank for 31% NaClO2 solution	gallons	4,106*
Diameter of each tank for 15% HCl solution	ft	9
Height of each tank for 15% HCl solution	ft	9
Number of tanks for 12.5% NaOCl solution	No.	2
Volume of each tank for 12.5% NaOCl solution	gallons	4,971*
Diameter of each tank for 15% HCl solution	ft	11
Height of each tank for 15% HCl solution	ft	7
Number of tanks for 15% HCl solution	No.	2
Volume of each tank for 15% HCl solution	gallons	4,106*
Diameter of each tank for 15% HCl solution	ft	9
Height of each tank for 15% HCl solution	ft	9
SBA Filters		
Number of filters	No.	7 total, 6 duty, 1 standby
Maximum flow per filter	mgd	20.2
Maximum flow per filter	gpm	14,000
Filter mesh size	µm	60
Assumed TSS	mg/L	16
Headloss through clean filter	psi	1.45
Headloss through clean filter	feet	3.35
Headloss through filter typically used to initiate backwash	psi	7.25
Headloss through filter typically used to initiate backwash	feet	16.73
Assumed backwash flow	gpm	420
Assumed backwash solids	lbs/day	4,000
SBA Backwash Clarifiers		
Number of lamella-plate clarifiers	No.	2 total (1 duty, 1 standby)
Assumed clarifier overflow flow	gpm	387
Assumed clarifier underflow wet solids flow	gpm	33
Assumed percent solids of wet solids	%	1
Quantity of wet solids at maximum flow	gal/day	48,034
Number of basins for wet solids storage for 4 days	No.	2
Volume of each basin for wet solids storage for 4 days	ft^3	12,992

Table 2-1. Preliminary Design Criteria for the Full-Barrier Strategy for the SBA System (cont.)

Clarifier Coagulant Dose and Storage		
Assumed aluminum sulfate dose	mg/L	20
Quantity of 48.5% $Al_2(SO_4)_3$ solution at maximum flow	lbs/day	101
Number of tanks for 48.5% $Al_2(SO_4)_3$ solution	No.	1
Volume of each tank for 48.5% $Al_2(SO_4)_3$ solution	gallons	265*
Diameter of each tank for 48.5% $Al_2(SO_4)_3$ solution	ft	4
Height of each tank for 48.5% $Al_2(SO_4)_3$ solution	ft	3
Dechlorination Dose and Storage for Filter Backwash Water		
Assumed sodium bisulfite dose	mg/L	4.39
Quantity of 25% $NaHSO_3$ solution at maximum flow	gal/day	8
Number of tanks for 25% $NaHSO_3$ solution	No.	1
Volume of each tank for 25% $NaHSO_3$ solution	gallons	120*
Diameter of each tank for 25% $NaHSO_3$ solution	ft	3
Height of each tank for 25% $NaHSO_3$ solution	ft	2.5
Piedmont Valve Lot Flows		
Maximum flow	cfs	185
Maximum flow	mgd	120
Typical flow	cfs	75
Typical flow	mgd	48
Piedmont Valve Lot Dechlorination Dose and Storage		
Assumed sodium bisulfite dose	mg/L	4.39
Quantity of 25% $NaHSO_3$ solution at maximum flow	gal/day	1,591
Number of tanks for 25% $NaHSO_3$ solution	No.	3
Volume of each tank for 25% $NaHSO_3$ solution	gallons	7,670*
Diameter of each tank for 25% $NaHSO_3$ solution	ft	12
Height of each tank for 25% $NaHSO_3$ solution	ft	9
Flows from SBA Terminal Tank to Percolation Pond Area		
Maximum flow	cfs	50
Maximum flow	mgd	32
Typical flow	cfs	5
Typical flow	mgd	3
SBA Terminal Tank Dechlorination Dose and Storage		
Assumed sodium bisulfite dose	mg/L	4.39
Quantity of 25% $NaHSO_3$ solution at maximum flow	gal/day	430
Number of tanks for 25% $NaHSO_3$ solution	No.	2
Volume of each tank for 25% $NaHSO_3$ solution	gallons	3,180*
Diameter of each tank for 25% $NaHSO_3$ solution	ft	9
Height of each tank for 25% $NaHSO_3$ solution	ft	7

Notes:

*Based on 14-day storage at maximum usage. Tank sizes may require adjusting to accommodate full delivery loads.

Key:

cfs = cubic feet per second
ft^3 = cubic feet
gal/day = gallons per day
gpm = gallons per minute
HCl = hydrochloric acid
lbs = pound
mg/L = milligrams per liter
mgd = million gallons per day
$NaClO_2$ = sodium chlorite
$NaHSO_3$ = sodium bisulfite
No. = number
psi = pounds per square inch
SBA = South Bay Aqueduct
SCMV = Santa Clara Meter Vault
TSS = total suspended solids

The mussels to be excluded by filtration are 0.75 millimeter (mm) to 3 centimeters (cm) and the recommended filter mesh sizes for consideration are 60 to 130 microns (µm) absolute with a weave wire construction. The advantages and disadvantages of filtration degrees within this range should be considered during detailed design. The design presented in this report uses a 60 µm filtration degree.

Two butterfly valves will be installed between the tees. During filter operation, the valves will be closed, and a 1-foot diameter drain pipe that is open to the atmosphere will be used to monitor for leaks from either butterfly valve. The valves may be opened after capping the drain pipe if a filter bypass is ever needed. A vault will be constructed to allow access to the valves and to inspect for valve leakage.

2.1.1 Hydraulic Considerations

Headlosses will be incurred through the mechanical filter system from the filters and the piping and appurtenances. Calculations to estimate headloss associated with the mechanical filter system are included as Appendix C.

Headloss across a clean mechanical filter will be 3.35 feet at 14,000 gallons per minute (gpm) through the filter. Backwashes are typically initiated when the headloss across a mechanical filter reaches 7.25 pounds per square inch (psi)[1] (16.73 feet). For the purpose of calculating the total system headloss, with several filters operating in parallel, 10 feet of headloss for the filters is assumed.

From the point of withdrawal to the point of return to the existing system, the new piping and appurtenances are estimated to contribute an additional 7 feet of headloss at the assumed maximum flow. This, combined with 10 feet of headloss through the filters, could result in a reduction of flow rates of approximately 8 to 18 percent. Possible mitigation measures for headloss that could be incorporated into this design[2] include adding pumps or adding extra filters to reduce flow through any one filter and the associated piping.

2.1.2 Backwash and Solids Handling

A water sample analyzed for total suspended solids (TSS) and particle size distribution (PSD) was collected from a location between the SBA Terminal Tank and Penitencia Water Treatment Plant on March 16, 2011. The results were 10 mg/L TSS, with 25 percent of the particles larger than 60-µm (see Appendix D for the laboratory report). The turbidity reading for March 16, 2011 at the same sample location was 6.5 nephelometric turbidity units (NTU). This turbidity value is relatively low for the SBA. Based on hourly turbidity readings collected from the SBA at Vallecitos from January 1, 2005 to April 18, 2011, the median turbidity was 9 NTU, the average was 10.5 NTU, the 95th-percentile was 24 NTU, and the maximum was 170 NTU. Turbidity was above 18 NTU less than 12 percent of the time and above 50 NTU less than 0.5 percent of the time (and generally occurring for less than half of a day). The assumed TSS value shown in Table 2-1 (16 mg/L) was calculated by dividing the March 16 TSS value by the March 16 turbidity reading and multiplying that factor by the average turbidity reading for the SBA.

---

[1] This is the recommended setpoint for Hydac RF3-7 filters. Amiad filters also use a backwashing setpoint of 7 psi. A lower setpoint may be selected for either brand, increasing the frequency of backwashes (and therefore the volume of water necessary for backwashing). More frequent backwashing will also lead to increased wear of the equipment.

[2] Another alternative would be to work in collaboration with other agencies that use SBA water to locate the facility (potentially with mitigation measures for headloss) at an upstream location.

The assumed backwash flow is 420 gpm. Backwash water will be conveyed to lamella-plate clarifiers (2 total, 1 duty, 1 standby). Information about Parkson lamella-plate clarifiers is included as Appendix E. Aluminum sulfate will be added as a coagulant aid to the flash mix tank at each clarifier. The assumed dose for this report is 20 mg/L, however, pilot testing is recommended to confirm the dose needed to achieve optimal flocculation and clarification. Aluminum sulfate will be stored in a tank located on the clarifier concrete pad. The tank has been sized to store the chemical for 14 days at maximum usage. Two aluminum sulfate metering pumps (1 duty, 1 standby) will also be located on the clarifier concrete pad.

Clarifier underflow will be stored on-site for transport by truck to a treatment plant (e.g., Penitencia Water Treatment Plant, Rinconada Water Treatment Plant, or San Jose-Santa Clara Water Pollution Control Plant) for dewatering. The underflow storage will be in three concrete basins that have been sized for four days at maximum flow.

Clarified water from the Parkson lamella-plate clarifiers may be transported by new pipe to Calera Creek for discharge, pending approval from the Regional Water Quality Control Board and California Department of Fish and Game (and possibly National Marine Fisheries Service and U.S. Fish and Wildlife Services). Clarified water is expected to have a maximum of 20 mg/L TSS.

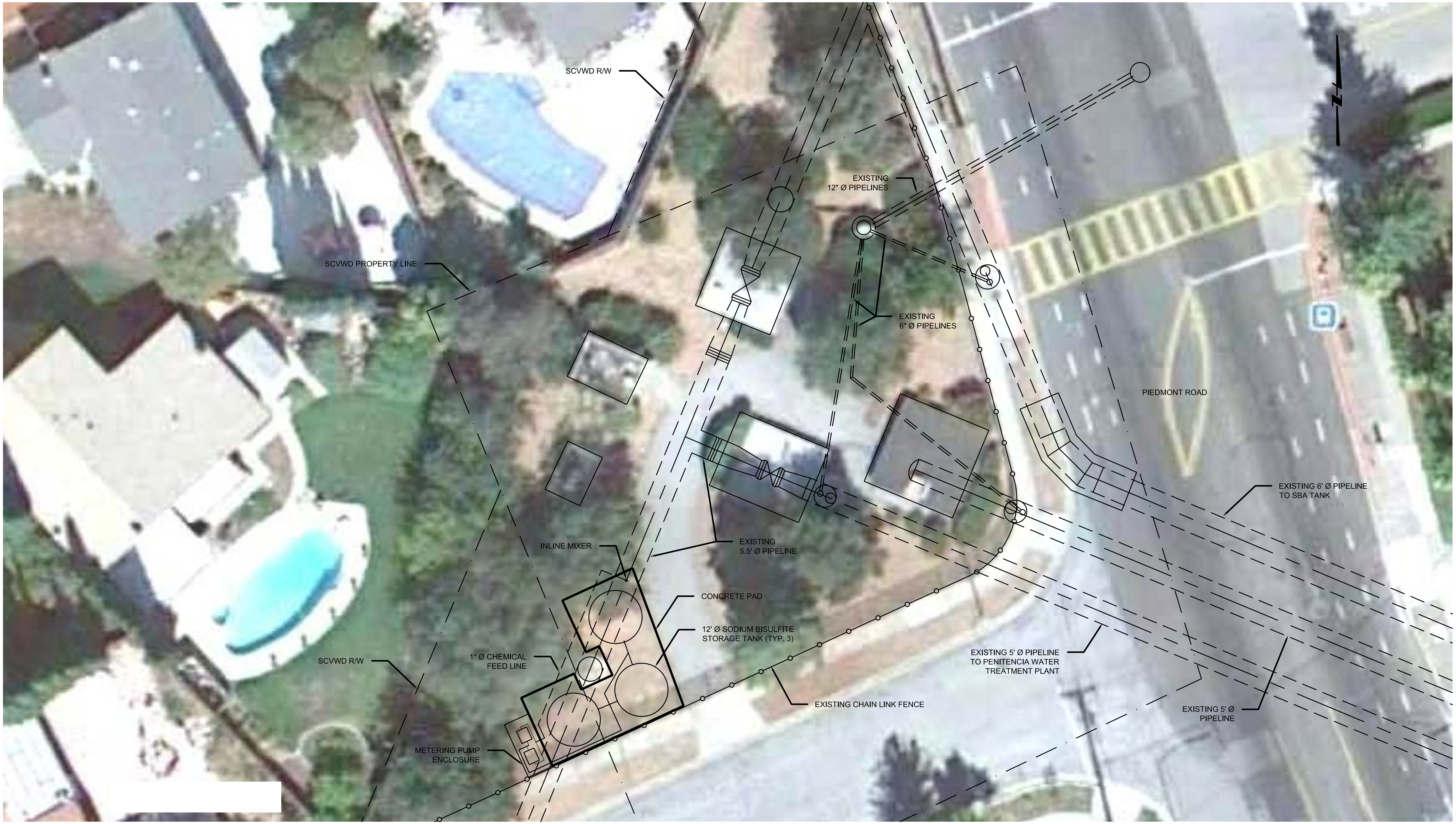
To ensure that no oxidant residual remains in the water discharged to Calera Creek, sodium bisulfite will be added to the clarifier overflow water. Sodium bisulfite will be stored in a tank located on the clarifier concrete pad. The tank has been sized to store the chemical for 14 days at maximum usage. Two sodium bisulfite metering pumps (1 duty, 1 standby) will also be located on the clarifier concrete pad.

2.1.3 Removal of Chlorine Dioxide Residual

Chlorine dioxide residual will be removed by injection of sodium bisulfite at the Piedmont Valve Lot and between the SBA Terminal Tank and the percolation pond area. Inline mixers are recommended for mixing the injected chemical at both sites.

Figure 2-4 shows the site layout for dechlorination at the Piedmont Valve Lot. Sodium bisulfite injection will ensure that no oxidant residual remains in the Central Pipeline that may be discharged to surface water at a downstream turnout. Sodium bisulfite will be stored in three tanks on a concrete pad to be located at the southwest corner of the lot. The tanks have been sized to store the chemical for 14 days at maximum usage. Two sodium bisulfite metering pumps (1 duty, 1 standby) will be located at the southwest corner of the lot.

Figure 2-5 shows the site layout for dechlorination at the SBA Terminal Tank. Dechlorination after the SBA Terminal Tank will ensure that no oxidant residual remains in water discharges to the percolation ponds. Sodium bisulfite will be stored in two tanks on a concrete pad to be located southeast of the SBA Terminal Tank. The tanks have been sized to store the chemical for 14 days at maximum usage. Two sodium bisulfite metering pumps (1 duty, 1 standby) will be located on the concrete pad.



\\swck1netapp1\mss\Projects\SCVWD–Invasive Mussels\6.0 STUDIES & REPORTS\6.1 Reports\Task 4 Conceptual Design\Drawings\FIGX–PLAN–PVY–XXXX.dwg May 24, 2011 – 5:48pm

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SITE LAYOUT FOR DECHLORINATION AT THE PIEDMONT VALVE YARD

SCALE
1" = 20'

JOB NO.

FIGURE 2–4

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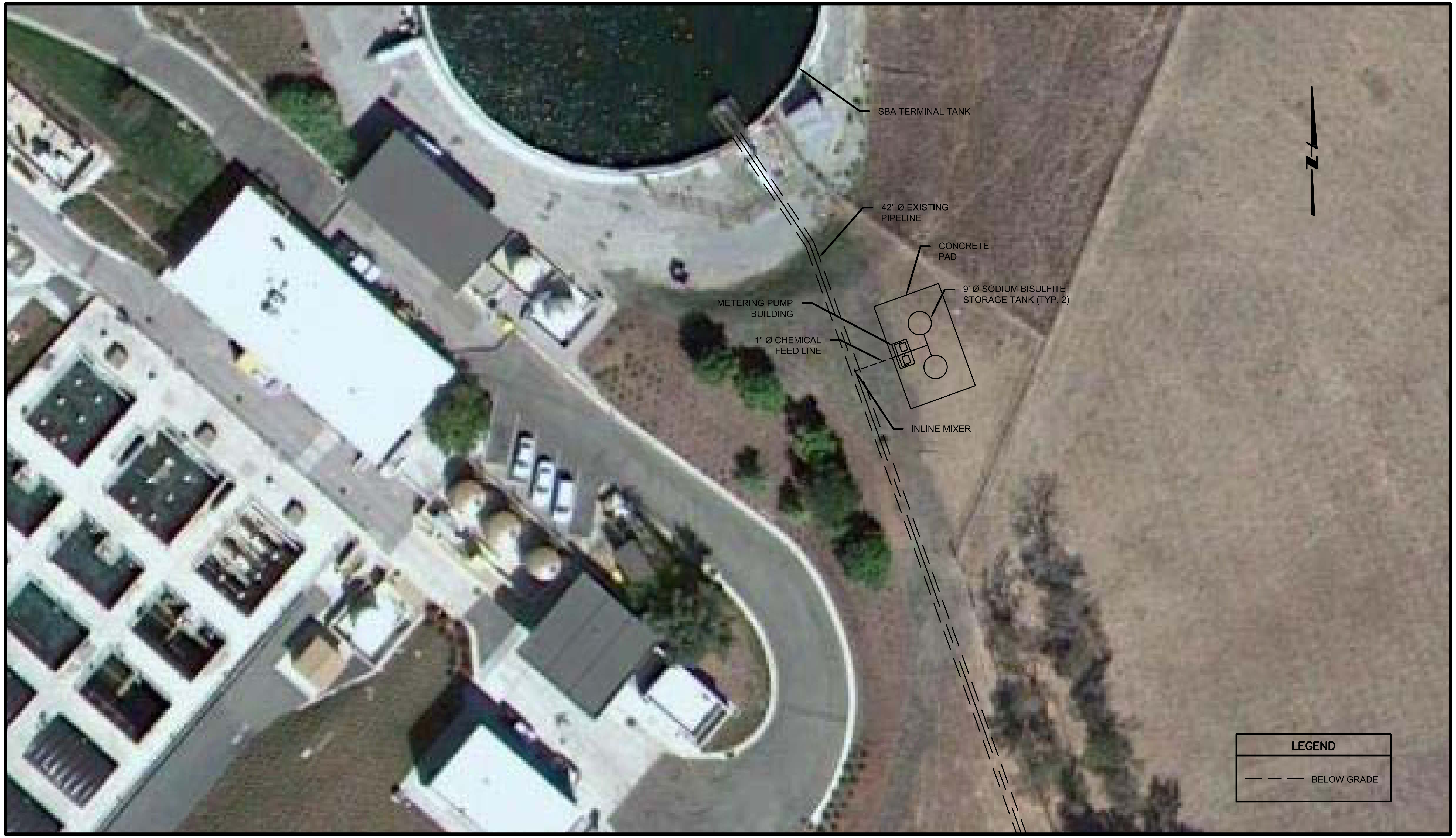

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SITE LAYOUT FOR DECHLORINATION AFTER THE SBA TERMINAL TANK

SCALE
1" = 40'

JOB NO.

FIGURE 2–5

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Chlorine dioxide residual will also be removed from clarified filter backwash water, as shown on Figures 2-1 and 2-2.

2.2 Cost Estimate for the Full-Barrier Strategy for the SBA System

The following sections present an estimate of project costs, including capital and operations and maintenance (O&M) costs, for the Full-Barrier Strategy for the SBA System.

2.2.1 Opinion of Probable Construction Costs

The Class 5 opinion of probable construction costs[3] (OPCC) for the Full-Barrier Strategy for the SBA System is included as Appendix F. Table 2-2 presents a summary of the OPCC.

Table 2-2. OPCC Summary for the Full-Barrier Strategy for the SBA System

Cost Description	Construction Costs
1. Equipment, Installation/Construction, Startup/Commission	$5,690,000
2. Mobilization/Field Oversight Expenses	$581,000
3. Parametric Contingency (10% of item 1)	$569,000
Subtotal 1	**$6,840,000**
4. Markups and State Sales Tax	$1,480,000
Subtotal 2	**$8,320,000**
5. Construction Oversight and Management (7% of Subtotal 2)	$582,000
6. Inspection (3% of Subtotal 2)	$250,000
7. Engineering (5% of Subtotal 2 + item 5)	$445,000
8. Permitting (3% of Subtotal 2)	$250,000
9. Administration/Legal Support (5% of Subtotal 2+ item 5+item 7)	$467,000
10. Scope Contingency/Market Conditions (20% of Subtotal 2+item 5+item 7+item 9)	$1,963,000
Total	**$12,277,000**
Expected Cost Range Per AACE cost estimate guidelines	$8.3 to $19.5 million

Key:
AACE = Association for the Advancement of Cost Engineering
OPCC = opinion of probable construction costs

The cost estimate uses budgetary values provided by Hydac for the mechanical filters. It should be noted that Amiad also provided budgetary numbers for a system that would be 40 percent less expensive, for a savings of approximately $450,000. As described in Section 2.1, Hydac filters were used for the designs in this report to minimize the footprint of the system. Additional discussions with these and other manufacturers of mechanical filters are recommended during future design phases to refine the cost estimates and assist in the selection of the best system to meet the District's objectives.

---

[3] MWH has no control over the costs of labor, materials or equipment, construction contractor's methods of determining bid prices, competitive bidding environments, unidentified field conditions, market conditions, inflation or any other factors that may affect the OPCC, the project budget or negotiating conditions at the time of execution of the construction contract. This OPCC deliverable is based on stable market conditions that exhibit predictable supply/demand relationships and does not attempt to capture the impacts of hyper-inflationary or deflationary market cycles. The OPCC is a "snapshot in time" and the reliability of the OPCC will degrade over time. Accordingly, MWH cannot and does not warrant or represent that construction bids or negotiated construction prices will not vary from the project budget or MWH's good faith Class 5 OPCC.

2.2.2 Estimate of Annual O&M Costs

Table 2-3 presents an estimate of annual O&M costs for the Full-Barrier Strategy for the SBA System.

Table 2-3. Estimate of Annual O&M Costs for the Full-Barrier Strategy for the SBA System

Cost Description	Annual O&M Costs
Assumes no additional pumping costs	--
Chemical costs for chlorine dioxide (1.4 mg/L)	$830,000
Chemical costs for sodium bisulfite (4.4 mg/L)	$81,000
Chemical costs for alum (20 mg/L)	$10,000
Transportation and disposal of wet solids	$1,005,000
Maintenance (5% of Equipment Cost)	$284,000
Labor (estimated at 1 FTE)	$100,000
Annual O&M Total	**$2,310,000**

Notes:
- These costs are approximate and were developed without detailed designs.

Key:
FTE = full time equivalent
mg/L = milligrams per liter
O&M = operations and maintenance

Transportation of wet solids (i.e., stored clarifier underflow water and sediment) represents 44 percent of the annual O&M costs. The estimate for this item is based on an average of 5 truckloads per day and a quote from Philips Service Corporation of $600 per load. This cost does not include any disposal fees once the material is delivered to the destination treatment plant. It may be more economical to provide mechanical dewatering at the site, and this option should be considered during future phases of design.

2.2.3 Estimate of Total Project Cost

Table 2-4 presents an estimate of total project life cycle costs for the Full-Barrier Strategy for the SBA System.

Table 2-4. Estimated Total Project Life Cycle Costs for the Full-Barrier Strategy for the SBA System

Capital Costs	**$12,277,000**
25-Year Present Worth Life Cycle Cost (R=5%)	$32,557,000
Total Project Cost (25-Year Present Worth)	**$45,000,000**

Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

Key:
R = Net interest rate

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3.0 Full-Barrier Strategy for the SLR System

As identified in the Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities (MWH, 2011), mechanical filters and chlorine dioxide addition was recommended as the Full-Barrier Strategy for the SLR system.

3.1 Conceptual Design for the Full-Barrier Strategy for the SLR System

A process flow diagram for the Full-Barrier Strategy for the SLR System is provided as Figure 3-1. Figure 3-2 shows the site layout for the Full-Barrier Strategy at the Pacheco Pump Plant. Figure 3-3 shows a section view of a mechanical filter and piping for the SLR System. Figure 3-4 shows a section view of chemical injection in Pacheco Tunnel Reach 1.

Preliminary design criteria for the Full-Barrier Strategy for the SLR System are presented in Table 3-1.

Chlorine dioxide will be manufactured on-site from sodium chlorite, sodium hypochlorite, and hydrochloric acid. A proposal from Dupont for a chlorine dioxide generator is included as Appendix A. A 3,000-ppm chlorine dioxide solution will be pumped through polyvinyl chloride (PVC)[4] pipe installed in the Pacheco Pump Plant Surge Shaft and Pacheco Tunnel Reach 1, and added to water immediately downstream[5] of the upper intake at San Luis Reservoir. More than one injection point should be considered during detailed design, to provide redundancy. The assumed chlorine dioxide dose is 1.4 mg/L, the maximum dose that can be added without risking formation of chlorite at concentrations above its MCL. Bench scale testing is recommended to confirm the demand and decay and pilot testing is recommended to confirm the dose needed to inactivate 100 percent of the mussel larvae that will pass through the mechanical filters.

A chemical storage building will be constructed to house the chemical tanks and chlorine dioxide generator. Tanks have been sized to store chemicals for 14 days at maximum usage.

Tees will be installed in the existing 120-inch pipe to divert water through a set of 18 mechanical filters operating in parallel. Header pipes (10 feet in diameter) to and from the entire filter system will be buried. Pipes (36-inch and 28-inch in diameter) to and from each filter will be above ground, with a concrete pad below the filter area.

---

[4] PVC is assumed for the purpose of cost estimation. Other materials, such as HDPE, should be considered during future design stages.

[5] Controls to prevent introduction of chlorine dioxide to SLR should be part of the chemical injection design, such as coordination between the chemical injection pumps and the water pumps at Pacheco Pump Plant.

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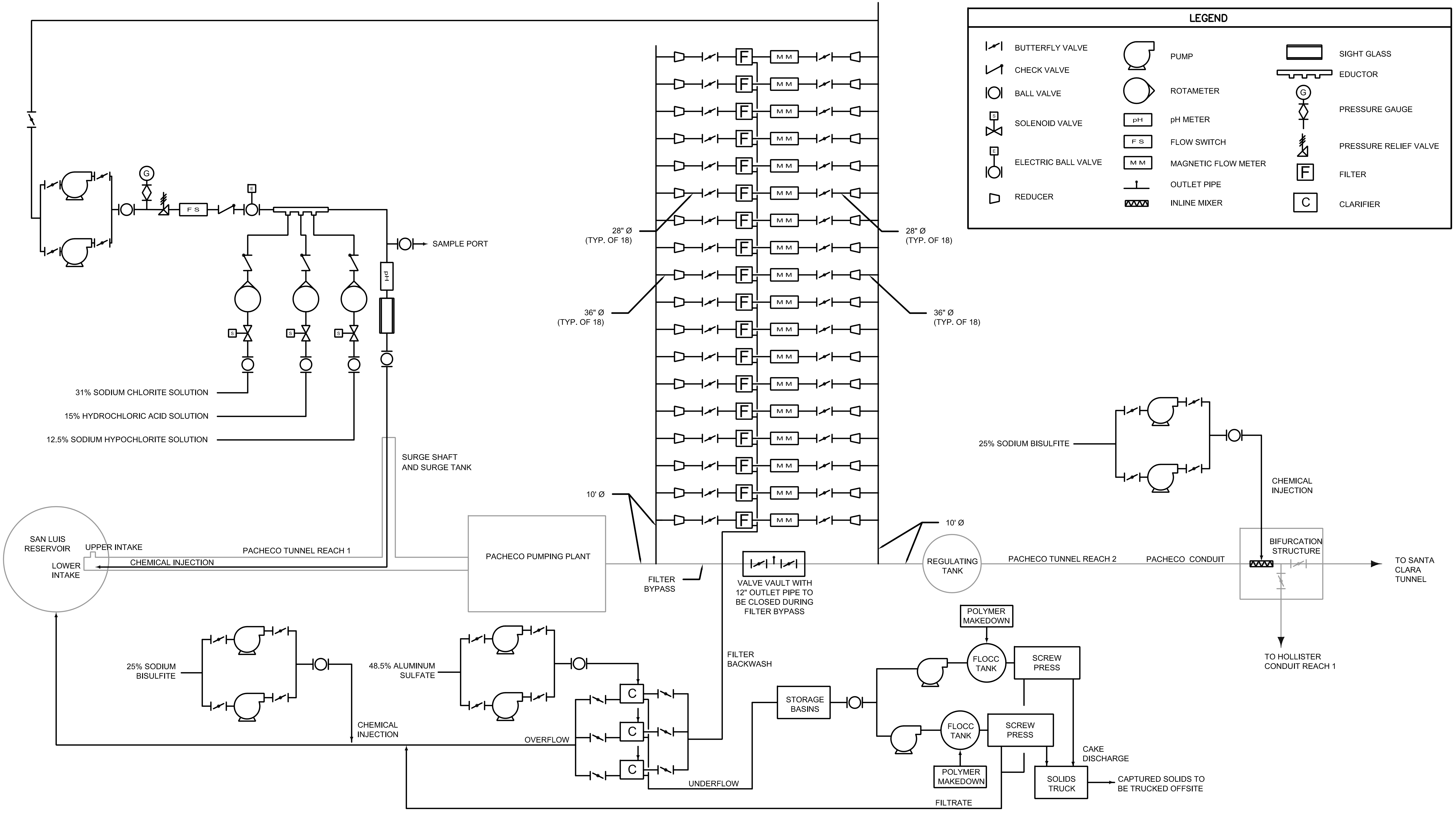

\\swcknetapp1\mes\Projects\SCVWD-Invasive Mussels\6.0 STUDIES & REPORTS\6.1 Reports\Task 4 Conceptual Design\Drawings\FIGX-PFD-PPP-9121.dwg May 24, 2011 - 5:44pm

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PROCESS FLOW DIAGRAM FOR FULL-BARRIER STRATEGY FOR THE SLR SYSTEM

SCALE
NO SCALE

JOB NO.

FIGURE 3–1

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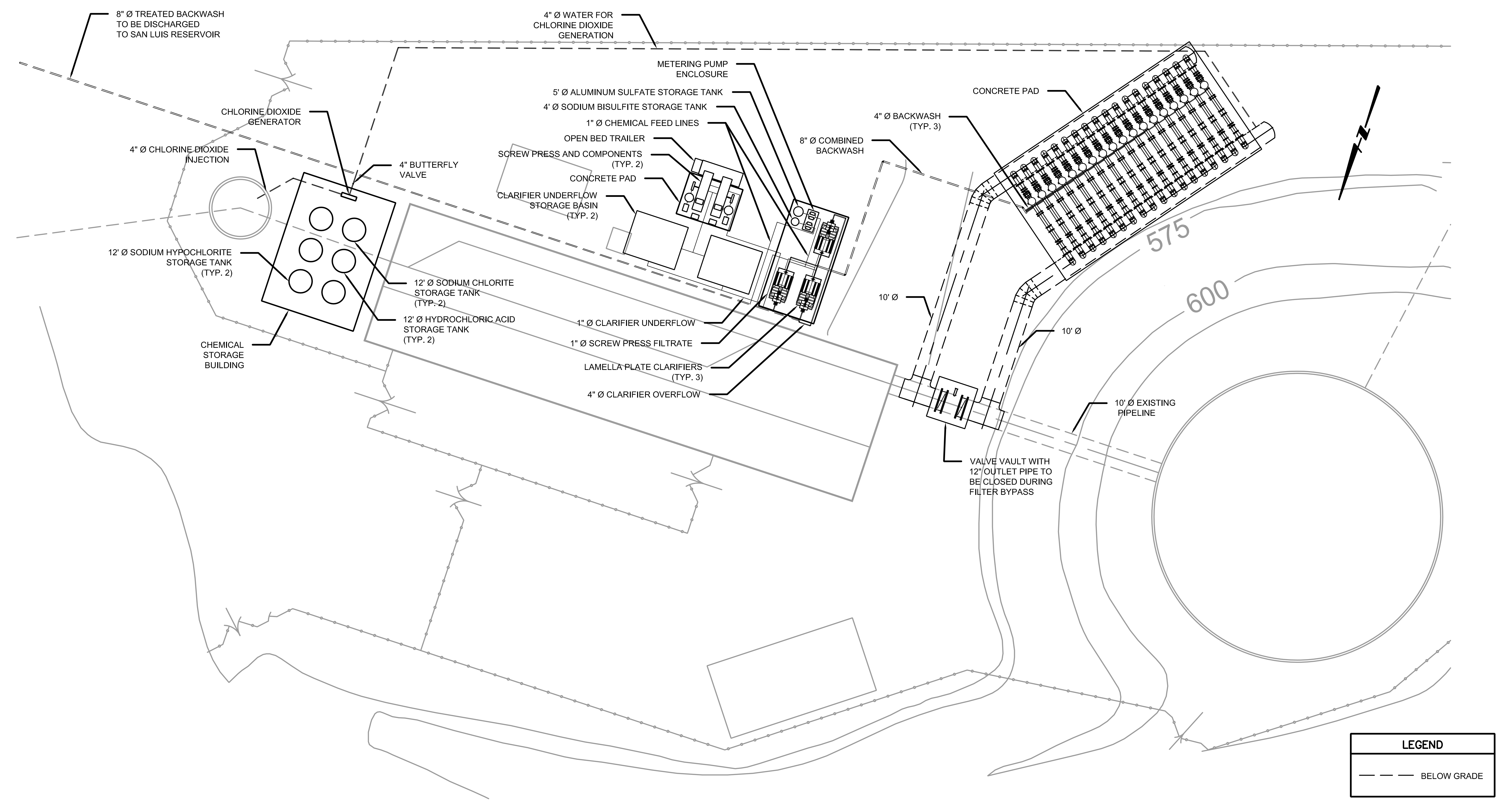
8" Ø TREATED BACKWASH TO BE DISCHARGED TO SAN LUIS RESERVOIR
4" Ø WATER FOR CHLORINE DIOXIDE GENERATION
METERING PUMP ENCLOSURE
5' Ø ALUMINUM SULFATE STORAGE TANK
4' Ø SODIUM BISULFITE STORAGE TANK
1" Ø CHEMICAL FEED LINES
OPEN BED TRAILER
SCREW PRESS AND COMPONENTS (TYP. 2)
CONCRETE PAD
CLARIFIER UNDERFLOW STORAGE BASIN (TYP. 2)
CHLORINE DIOXIDE GENERATOR
4" Ø CHLORINE DIOXIDE INJECTION
4" BUTTERFLY VALVE
12' Ø SODIUM HYPOCHLORITE STORAGE TANK (TYP. 2)
12' Ø SODIUM CHLORITE STORAGE TANK (TYP. 2)
12' Ø HYDROCHLORIC ACID STORAGE TANK (TYP. 2)
CHEMICAL STORAGE BUILDING
1" Ø CLARIFIER UNDERFLOW
1" Ø SCREW PRESS FILTRATE
LAMELLA PLATE CLARIFIERS (TYP. 3)
4" Ø CLARIFIER OVERFLOW
CONCRETE PAD
4" Ø BACKWASH (TYP. 3)
8" Ø COMBINED BACKWASH
575
600
10' Ø
10' Ø
10' Ø EXISTING PIPELINE
VALVE VAULT WITH 12" OUTLET PIPE TO BE CLOSED DURING FILTER BYPASS
LEGEND
BELOW GRADE

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SITE LAYOUT FOR FULL-BARRIER STRATEGY AT THE PACHECO PUMP PLANT

SCALE
1" = 50'

JOB NO.

FIGURE 3–2

\\Usewcknetapp1\mse\Projects\SCVWD-Invasive Mussels\6.0 STUDIES & REPORTS\6.1 Reports\Task 4 Conceptual Design\Drawings\FIGX-PLAN-PPP-9121.dwg May 24, 2011 - 5:47pm

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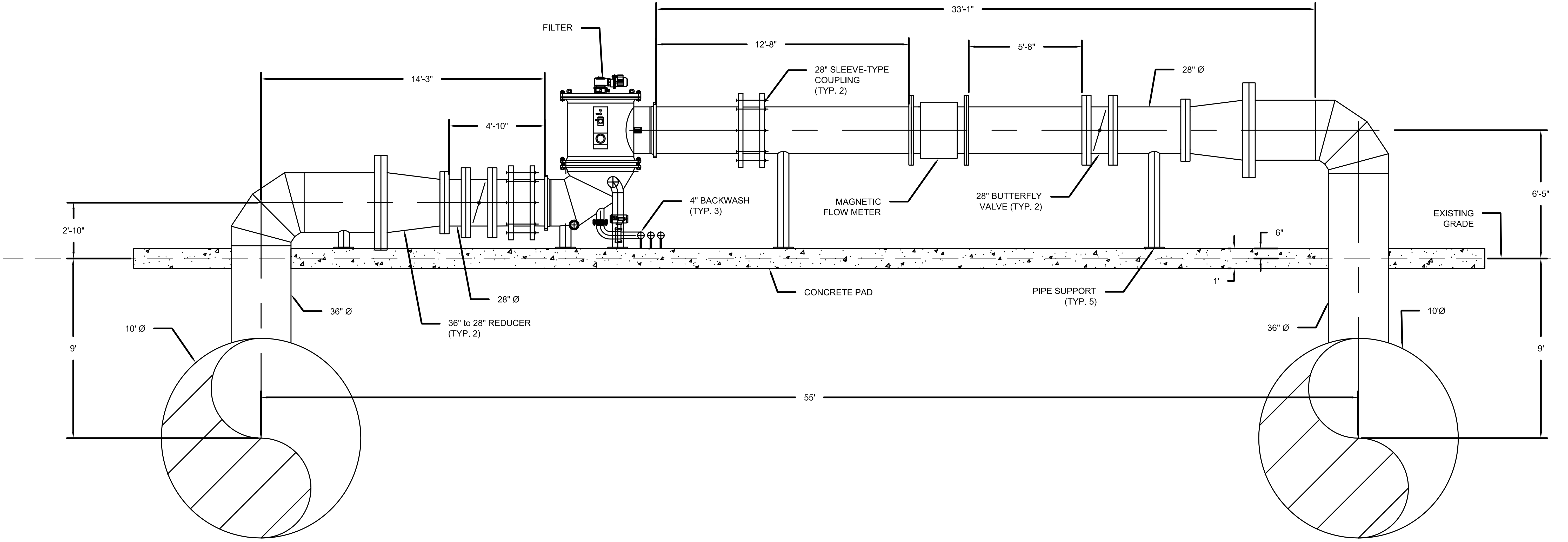

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SECTION VIEW OF THE MECHANICAL FILTER AND
PIPING AT THE PACHECO PUMP PLANT

SCALE
1" = 5'

JOB NO.

FIGURE 3–3

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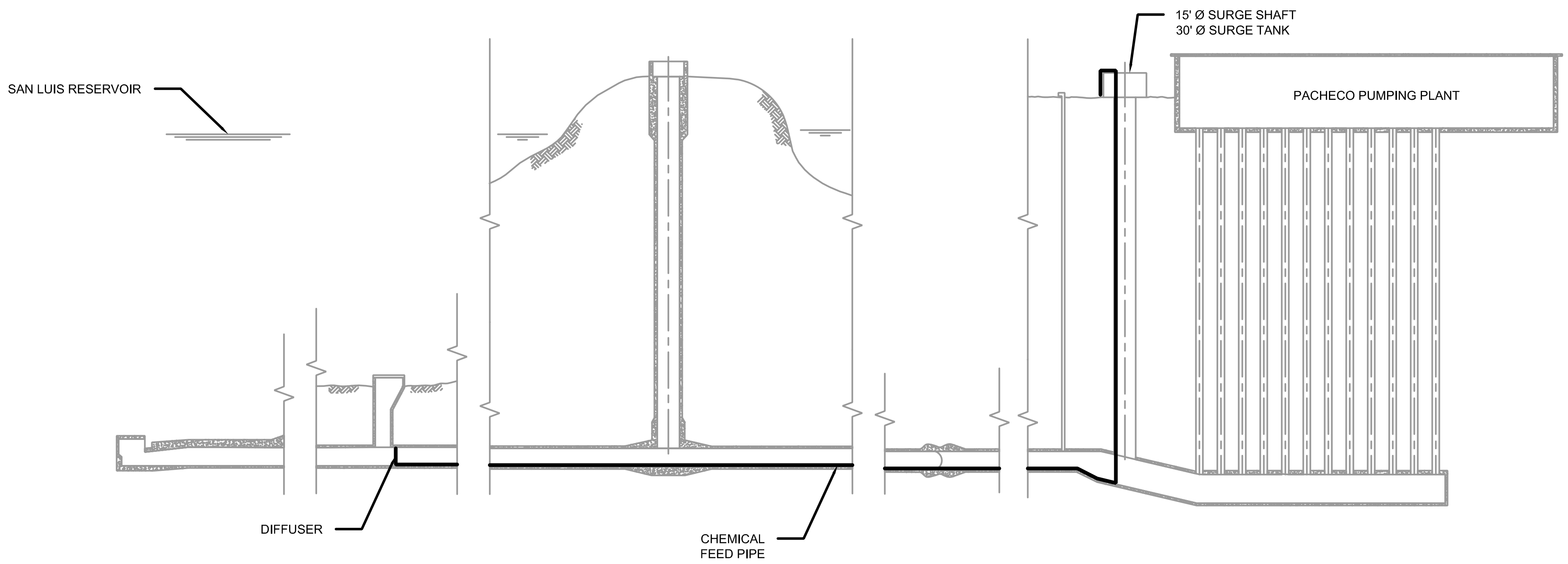

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SECTION VIEW OF CHEMICAL INJECTION IN PACHECO TUNNEL REACH 1

SCALE
1" = 100'

JOB NO.

FIGURE 3–4

\\Uswck1netapp1\mss\Projects\SCVWD–Invasive Mussels\6.0 STUDIES & REPORTS\6.1 Reports\Task 4 Conceptual Design\Drawings\FIGX–WWPF–PPP–9121.dwg May 24, 2011 – 5:51pm

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Table 3-1. Preliminary Design Criteria for the Full-Barrier Strategy for the SLR System

Description	Units	Criteria
Pacheco Pump Plant Flows		
Maximum flow	cfs	480
Maximum flow	mgd	310
Typical flow	cfs	225
Typical flow	mgd	145
Pacheco Pump Plant Chlorine Dioxide Dose and Storage		
Assumed chlorine dioxide dose	mg/L	1.4
Type of chlorine dioxide generator system	--	3-chemical
Quantity of 31% NaClO2 solution at maximum flow	lbs/day	15,673
Quantity of 12.5% NaOCl solution at maximum flow	lbs/day	17,917
Quantity of 15% HCl solution at maximum flow	lbs/day	13,030
Number of tanks for 31% $NaClO_2$ solution	No.	2
Volume of each tank for 31% $NaClO_2$ solution	gallons	10,289*
Diameter of each tank for 31% $NaClO_2$ solution	ft	12
Height of each tank for 31% $NaClO_2$ solution	ft	12
Number of tanks for 12.5% NaOCl solution	No.	2
Volume of each tank for 12.5% NaOCl solution	gallons	13,828*
Diameter of each tank for 12.5% NaOCl solution	ft	12
Height of each tank for 12.5% NaOCl solution	ft	16
Number of tanks for 15% HCl solution	No.	2
Volume of each tank for 15% HCl solution	gallons	10,289*
Diameter of each tank for 15% HCl solution	ft	12
Height of each tank for 15% HCl solution	ft	12
Pacheco Pump Plant Filters		
Number of filters	No.	18 total, 16 duty, 2 standby
Maximum flow per filter	mgd	20.2
Maximum flow per filter	gpm	14,000
Filter mesh size	µm	60
Assumed TSS	mg/L	4.5
Headloss through clean filter	psi	1.45
Headloss through clean filter	feet	3.35
Headloss through filter typically used to initiate backwash	psi	7.25
Headloss through filter typically used to initiate backwash	feet	16.73
Assumed backwash flow	gpm	840
Assumed backwash solids	lbs/day	2,900
Pacheco Pump Plant Backwash Clarifiers		
Number of lamella-plate clarifiers	No.	3 total (2 duty, 1 standby)
Assumed clarifier overflow flow	gpm	816
Assumed clarifier underflow wet solids flow	gpm	24
Assumed percent solids of wet solids	%	1
Quantity of wet solids at maximum flow	gal/day	34,900
Number of basins for wet solids storage for 4 days	No.	2
Volume of each basin for wet solids storage for 4 days	ft^3	9,338

Table 3-1. Preliminary Design Criteria for the Full-Barrier Strategy for the SLR System (cont.)

Pacheco Pump Plant Mechanical Dewatering		
Assumed hours of dewatering operation per day	hrs	6
Assumed minimum days of dewatering operation per week	days	4
Assumed maximum loading rate of dewatering system	gpm (lbs/min)	170 (1,415)
Number of screw presses	No.	2
Polymer storage volume	ft^3	TBD in detailed design
Assumed solids capture by screw press dewatering	%	95
Assumed percent solids of screw press cake discharge	%	25
Quantity of cake discharge at maximum flow	lbs/day	11,060
Assumed screw press filtrate flow	gpm	TBD in detailed design
Clarifier Coagulant Dose and Storage		
Assumed aluminum sulfate dose	mg/L	20
Quantity of 48.5% $Al_2(SO_4)_3$ solution at maximum flow	lbs/day	202
Number of tanks for 48.5% $Al_2(SO_4)_3$ solution	No.	1
Volume of each tank for 48.5% $Al_2(SO_4)_3$ solution	gallons	552*
Diameter of each tank for 48.5% $Al_2(SO_4)_3$ solution	ft	5
Height of each tank for 48.5% $Al_2(SO_4)_3$ solution	ft	4
Dechlorination Dose and Storage for Filter Backwash Water		
Assumed sodium bisulfite dose	mg/L	4.39
Quantity of 25% $NaHSO_3$ solution at maximum flow	lbs/day	44
Number of tanks for 25% $NaHSO_3$ solution	No.	1
Volume of each tank for 25% $NaHSO_3$ solution	gallons	265*
Diameter of each tank for 25% $NaHSO_3$ solution	ft	4
Height of each tank for 25% $NaHSO_3$ solution	ft	3
Hollister Bifurcation Flow		
Maximum flow	cfs	480
Maximum flow	mgd	310
Typical flow	cfs	225
Typical flow	mgd	145
Hollister Bifurcation Dechlorination Dose and Storage		
Assumed sodium bisulfite dose	mg/L	4.39
Quantity of 25% $NaHSO_3$ solution at maximum flow	gal/day	4,122
Number of tanks for 25% $NaHSO_3$ solution	No.	6
Volume of each tank for 25% $NaHSO_3$ solution	gallons	10,289*
Diameter of each tank for 25% $NaHSO_3$ solution	ft	12
Height of each tank for 25% $NaHSO_3$ solution	ft	12

Notes:
*Based on 14-day storage at maximum usage. Tank sizes may require adjusting to accommodate full delivery loads.

Key:
$Al_2(SO_4)_3$ = aluminum sulfate
cfs = cubic feet per second
ft = feet
ft^3 = cubic feet
gal = gallons
gpm = gallons per minute
HCl = hydrochloric acid
lbs = pound
mg/L = milligrams per liter
mgd = million gallons per day
min = minutes
$NaClO_2$ = sodium chlorite
$NaHSO_3$ = sodium bisulfite
No. = number
psi = pounds per square inch
TBD = to be determined
TSS = total suspended solids

The design criteria, site layouts, and cost estimates in this report use Hydac filters to minimize the overall system footprint (18 Hydac filters instead of 20 Amiad filters with a 13 percent larger diameter per filter). Hydac, Amiad, and other filter manufacturers should be contacted during detailed design and the advantages and disadvantages of each make and model should be carefully considered to assist in the selection of the best system to meet the District's objectives.

The mussels to be excluded by filtration are 0.75 mm to 3 cm and the recommended filter mesh sizes for consideration are 60 to 130 µm absolute with a weave wire construction. The advantages and disadvantages of filtration degrees within this range should be considered during detailed design. The design presented in this report uses a 60 µm filtration degree.

Two butterfly valves will be installed between the tees. During filter operation, the valves will be closed, and a 1-foot diameter drain pipe that is open to the atmosphere will be used to monitor for leaks from either butterfly valve. The valves may be opened after capping the drain pipe if a filter bypass is ever needed. A vault will be constructed to allow access to the valves and to inspect for valve leakage.

3.1.1 Hydraulic Considerations

Headlosses will be incurred through the mechanical filter system from the filters and the piping and appurtenances. Calculations to estimate headloss associated with the mechanical filter system are included as Appendix G.

Headloss across a clean mechanical filter will be 3.35 feet at 14,000 gpm through the filter. Backwashes are typically initiated when the headloss across a mechanical filter reaches 7.25 psi (16.73 feet). For the purpose of calculating the total system headloss, with several filters operating in parallel, we have assumed 10 feet of headloss for the filters.

From the point of withdrawal to the point of return to the existing system, the new piping and appurtenances will contribute an additional 10 feet of headloss at the assumed maximum flow. This, combined with 10 feet of headloss through the filters, could result in a reduction of flow rates. Pump curves for the Pacheco Pump Plant pumps should be reviewed to determine the impacts to flow that the additional head would cause.

3.1.2 Backwash and Solids Handling

A water sample analyzed for TSS was collected from the water quality station sample line at the Pacheco Pump Plant on March 16, 2011. The results were <5 mg/L TSS (see Appendix D for the laboratory report). The TSS concentration was not high enough to run the PSD. The turbidity reading for March 16, 2011 at Pacheco Pump Plant was 1.88 NTU. Based on daily turbidity readings collected from Pacheco Pump Plant from January 1, 2005 to October 6, 2010, the median and average turbidity was approximately 3 NTU, the 95th-percentile was less than 6 NTU, and the maximum was 13.37 NTU. The assumed TSS value shown in Table 3-1 (4.5 mg/L) was calculated by multiplying a factor of 1.5 by the average turbidity reading for Pacheco Pump Plant.

The assumed backwash flow is 840 gpm. Backwash water will be conveyed to lamella-plate clarifiers (3 total, 2 duty, 1 standby). Information about Parkson lamella-plate clarifiers is included as Appendix E. Aluminum sulfate will be added as a coagulant aid to the flash mix tank at each clarifier. The assumed dose for this report is 20 mg/L, however, pilot testing is recommended to confirm the dose needed to achieve optimal flocculation and clarification. Aluminum sulfate will be stored in a tank located on the clarifier concrete pad. The tank has been sized to store the chemical for 14 days at maximum usage. Two aluminum sulfate metering pumps (1 duty, 1 standby) will also be located on the clarifier concrete pad.

Clarifier underflow water will be stored (because the mechanical dewatering equipment will not be operated continuously) in two on-site basins. The basins have been sized to store clarifier underflow water for 4 days at maximum usage.

Clarifier underflow will be further dewatered using two on-site screw presses located downstream of the storage basins. Each screw press is sized to accommodate 170 gpm, half of the maximum flow rate expected when operated 6 hours a day, 4 days a week. If a screw press requires maintenance, the second screw press can be run for an additional shift to treat the necessary flow.

Clarified water from the Parkson lamella-plate clarifiers and filtrate from the screw presses may be transported by new pipe to San Luis Reservoir for discharge, pending approval from the Regional Water Quality Control Board and the U.S. Department of the Interior, Bureau of Reclamation (Reclamation). Clarified water is expected to have a maximum of 20 mg/L TSS.

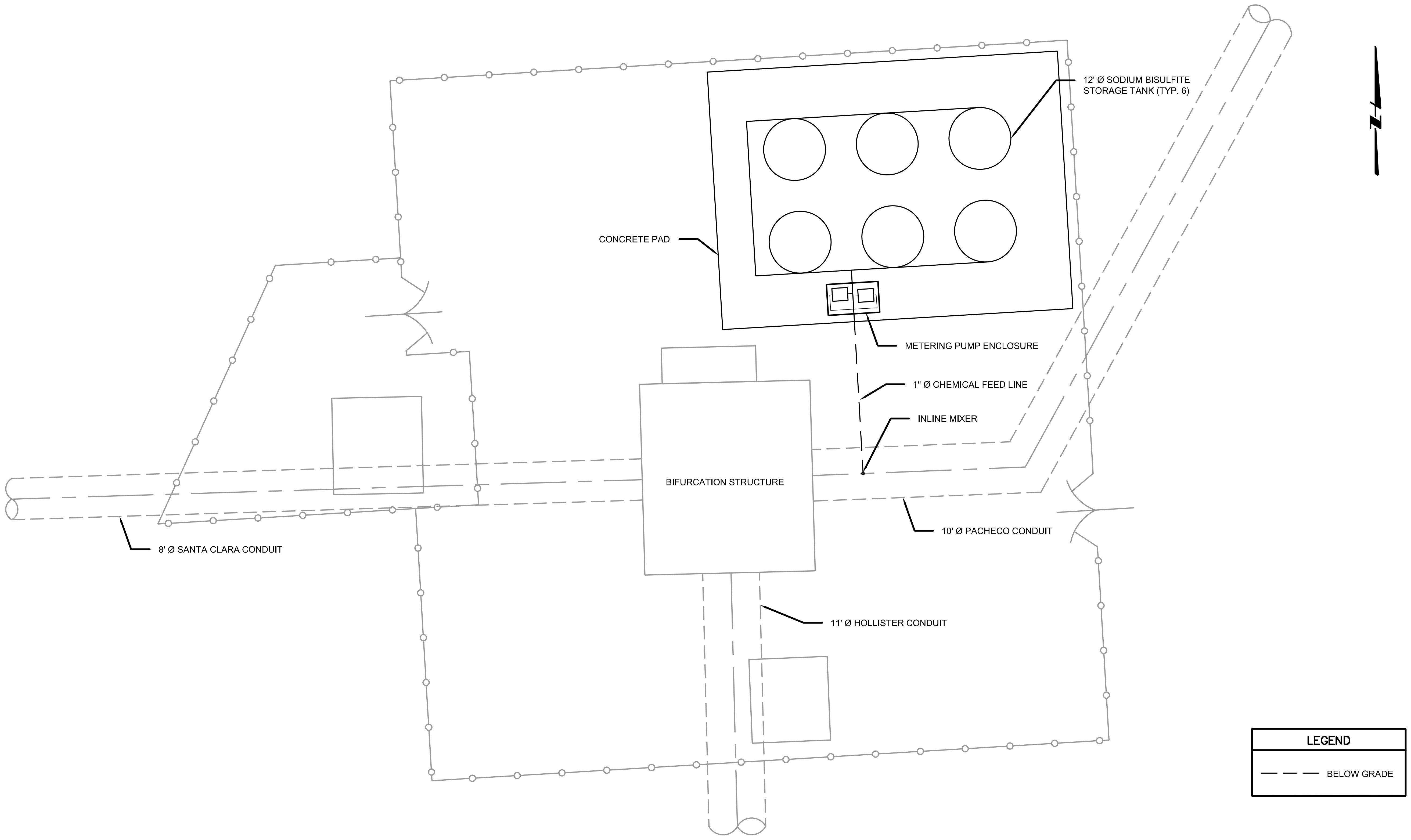
To ensure that no oxidant residual remains in the water discharged to San Luis Reservoir, sodium bisulfite will be added to the combined of the clarifier overflow and filtrate. Sodium bisulfite will be stored in a tank located on the clarifier concrete pad. The tank has been sized to store the chemical for 14 days at maximum usage. Two sodium bisulfite metering pumps (1 duty, 1 standby) will also be located on the clarifier concrete pad.

Cake discharge from the screw presses will be collected in open-bed semi trucks for hauling to a disposal site. The open bed of the truck on-site will be positioned such that the bed of the truck is directly below the cake discharge outlet of the two screw presses. The position of the truck will require adjustment as needed during loading in order to achieve an even distribution of solids throughout the bed. Two trucks will be required per 6-hour loading period during maximum production; one truck will receive the cake discharge on-site while the other is hauling the previous load off-site.

3.1.3 Removal of Chlorine Dioxide Residual

Chlorine dioxide residual will be removed by injection of sodium bisulfite at the Hollister Bifurcation Structure. Inline mixers are recommended for mixing the injected chemical.

Figure 3-5 shows the site layout for dechlorination at the Hollister Bifurcation Structure. Sodium bisulfite will be injected into the Pacheco Conduit upstream of the bifurcation structure to ensure that no oxidant residual remains in the Santa Clara Conduit or the Hollister Conduit that might be discharged to surface water. Sodium bisulfite will be stored in two tanks on a concrete pad to be located at the northeast corner of the fenced area. The tanks have been sized to store the chemical for 14 days at maximum usage. Two sodium bisulfite metering pumps (1 duty, 1 standby) will be located on the concrete pad.



\\Uswck1netapp1\mss\Projects\SCVWD-Invasive Mussels\6.0 STUDIES & REPORTS\6.1 Reports\Task 4 Conceptual Design\Drawings\FIGX-PLAN-HOLL-XXXX.dwg May 24, 2011 – 5:46pm

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Santa Clara Valley Water District

SITE LAYOUT FOR DECHLORINATION AT THE HOLLISTER BIFURCATION

SCALE
1" = 20'

JOB NO.

FIGURE 3–5

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Chlorine dioxide residual will also be removed from backwash water that has passed through the clarifiers and/or mechanical dewatering system, as shown on Figures 3-1 and 3-2.

3.2 Cost Estimate for the Full-Barrier Strategy for the SLR System

The following sections present an estimate of project costs, including capital and O&M costs, for the Full-Barrier Strategy for the SLR System.

3.2.1 Opinion of Probable Construction Costs

The Class 5 OPCC for the Full-Barrier Strategy for the SLR System is included as Appendix H. Table 3-2 presents a summary of the OPCC.

Table 3-2. OPCC Summary for the Full-Barrier Strategy for the SLR System

Cost Description	Construction Costs
1. Equipment, Installation/Construction, Startup/Commission	$14,040,000
2. Mobilization/Field Oversight Expenses	$1,439,000
3. Parametric Contingency (10% of item 1)	$1,404,000
Subtotal 1	**$16,883,000**
4. Markups and State Sales Tax	$3,657,000
Subtotal 2	**$20,540,000**
5. Construction Oversight and Management (7% of Subtotal 2)	$1,438,000
6. Inspection (3% of Subtotal 2)	$616,000
7. Engineering (5% of Subtotal 2 + item 5)	$1,099,000
8. Permitting (3% of Subtotal 2)	$616,000
9. Administration/Legal Support (5% of Subtotal 2+ item 5+item 7)	$1,154,000
10. Scope Contingency/Market Conditions (20% of Subtotal 2+item 5+item 7+item 9)	$4,846,000
Total	**$30,309,000**
Expected Cost Range Per AACE cost estimate guidelines	$20.4 to $48.1 million

Key:
AACE = Association for the Advancement of Cost Engineering
OPCC = opinion of probable construction costs

The cost estimate uses budgetary values provided by Hydac for the mechanical filters. It should be noted that Amiad also provided budgetary numbers for a system that would be 40 percent less expensive, for a savings of approximately $1,200,000. As described in Section 3.1, Hydac filters were used for the designs in this report to minimize the footprint of the system. Additional discussions with these and other manufacturers of mechanical filters are recommended during future design phases to refine the cost estimates and assist in the selection of the best system to meet the District's objectives.

3.2.2 Estimate of Annual O&M Costs

Table 3-3 presents an estimate of annual O&M costs for the Full-Barrier Strategy for the SLR System.

Table 3-3. Estimate of Annual O&M Costs for the Full-Barrier Strategy for the SLR System

Cost Description	Annual O&M Costs
Assumes no additional pumping costs	--
Chemical costs for chlorine dioxide (1.4 mg/L)	$2,189,000
Chemical costs for sodium bisulfite (4.4 mg/L)	$221,000
Chemical costs for alum (20 mg/L)	$12,000
Transportation and disposal of solids	$52,000
Maintenance (5% of Equipment Cost)	$701,000
Labor (estimated at 2 FTE)	$200,000
Annual O&M Total	**$3,375,000**

Notes:
- These costs are approximate and were developed without detailed designs.

Key:
FTE = full-time equivalent
mg/L = milligrams per liter
O&M = operations and maintenance

The estimate of costs for transportation and disposal of solids (i.e., cake from the screw press) is based on current costs (approximately $29 per ton) to dispose of similar material from Penitencia Water Treatment Plant at Newby Island Sanitary Landfill in Milpitas, California, as communicated by Mr. John Cook, SCVWD, on May 17, 2011 and the cost of fuel for each round trip from Pacheco Pump Plant to Newby Island Sanitary Landfill. The cost of two trucks is included in the OPCC, and the driver is included in the O&M costs as one full-time equivalent (FTE).

3.2.3 Estimate of Total Project Cost

Table 3-4 presents an estimate of total project life cycle costs for the Full-Barrier Strategy for the SLR System.

Table 3-4. Estimated Total Project Life Cycle Costs for the Full-Barrier Strategy for the SLR System

Capital Costs	$30,309,000
25-Year Present Worth Life Cycle Cost (R=5%)	$47,567,000
Total Project Cost (25-Year Present Worth)	**$78,000,000**

Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

Key:
R = Net interest rate

4.0 Partial-Protection Strategy for the SBA System

As identified in the Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities (MWH, 2011), the recommended Partial-Protection Strategy for the SBA System involves periodic potassium[6] addition near the same location as the Full-Barrier Strategy. This strategy could be used to protect large portions of the raw water system downstream of the injection point, including vulnerable equipment (e.g., systems for pump cooling water or fire suppression). This strategy is still considered to be partially-protective in that it does not protect reservoirs and other water bodies that receive water from the raw water system, and it is not intended to be operated continuously. In many ways, the strategy is similar to Reactive Mitigation Alternative 3 (MWH, 2011), but will be applied on a regular basis as a maintenance practice for vulnerable equipment and other segments of the raw water system. This system could provide a secondary benefit because it offers some mitigation should mussels get into the system downstream of the Full-Barrier Strategy. Potassium would be much more persistent in the raw water system than chlorine dioxide, making it more effective further downstream for killing settled mussels in the raw water infrastructure.

4.1 Conceptual Design for the Partial-Protection Strategy for the SBA System

The Partial-Protection Strategy involves addition of a potassium chloride solution directly to the SBA near the Santa Clara Meter Vault for a 52-day period each year. The assumed potassium dose is 20 mg/L (pilot testing is recommended to confirm the dose). To reduce the size of the system and annual O&M costs, it is assumed that the potassium addition will occur between the beginning of November and the end of February, when imported water deliveries are typically low.

A process flow diagram for the Partial-Protection Strategy for the SBA System is provided as Figure 4-1. Figure 4-2 shows the site layout for the Partial-Protection Strategy near the Santa Clara Meter Vault.

Preliminary design criteria for the Partial-Protection Strategy for the SBA System are presented in Table 4-1.

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[6] Depending on the results of ongoing trials and product availability, Zequanox™ may be a good alternative to potassium and should be considered during detailed design if more product information is available at that time.

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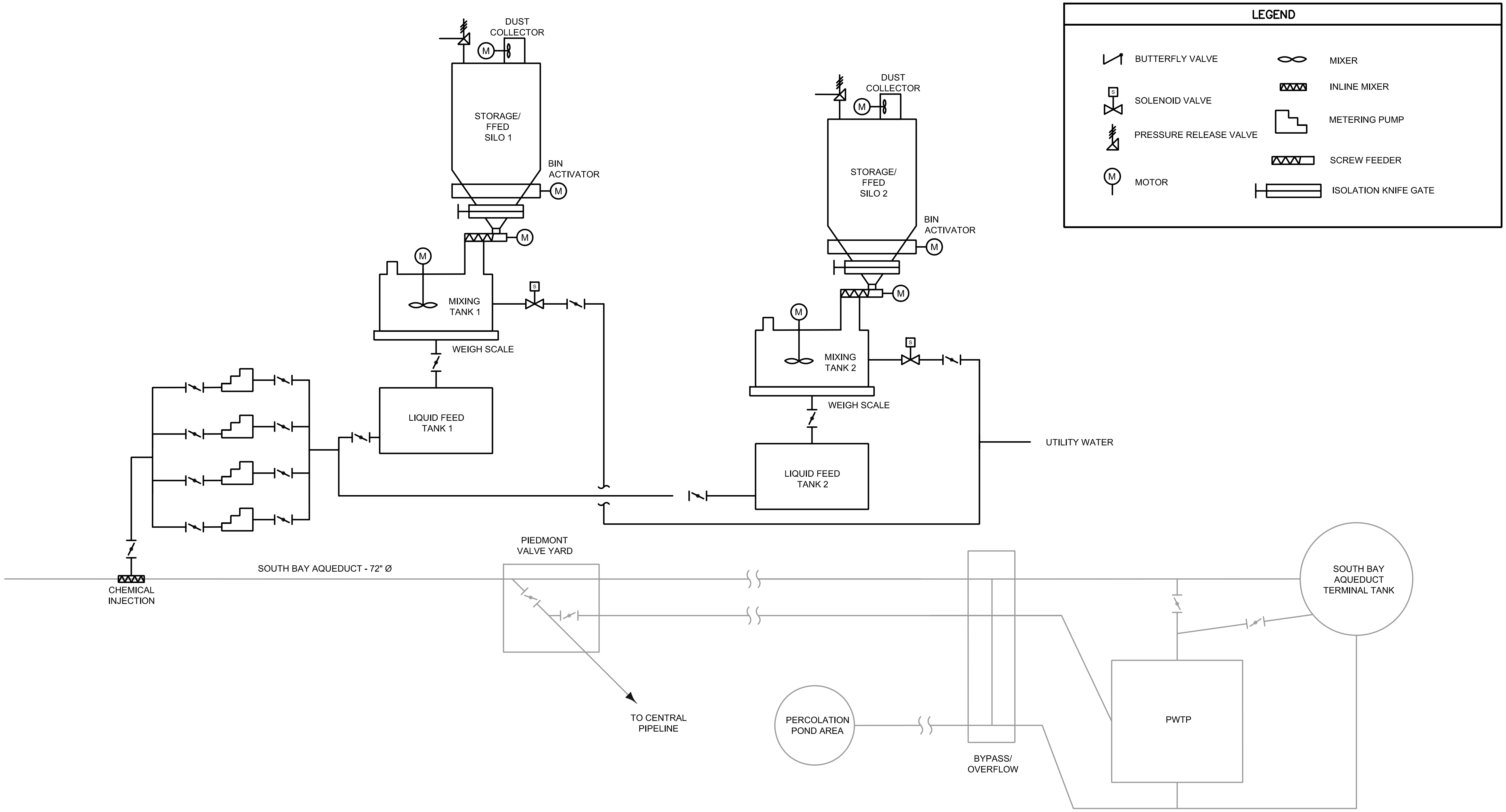

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Santa Clara Valley Water District

PROCESS FLOW DIAGRAM FOR PARTIAL-PROTECTION STRATEGY FOR THE SBA SYSTEM

SCALE
NO SCALE

JOB NO.

FIGURE 4–1

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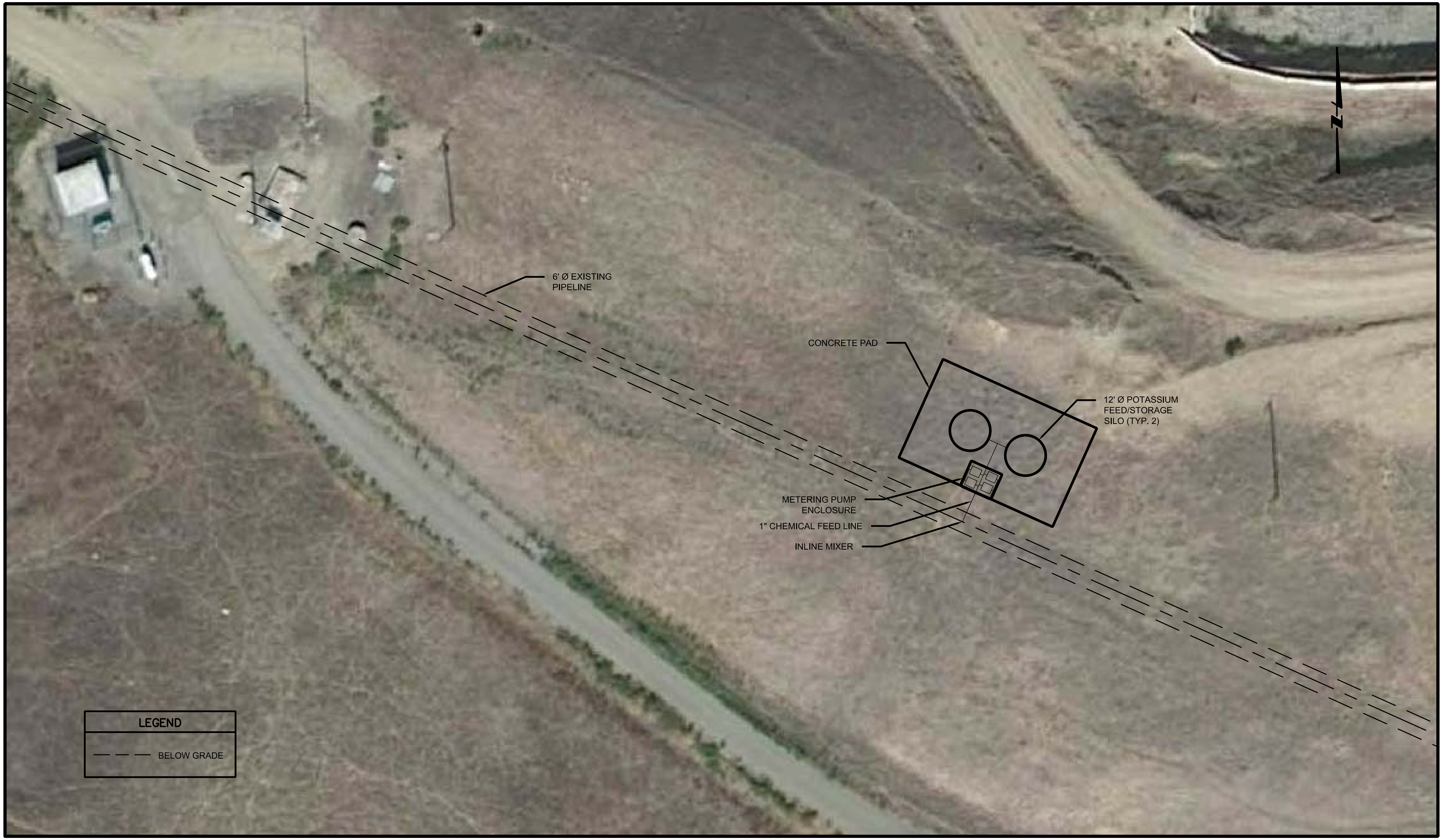

\\Uswck1netapp1\mss\Projects\SCVWD-Invasive Mussels\6.0 STUDIES & REPORTS\6.1 Reports\Task 4 Conceptual Design\Drawings\FIGX-PARTIAL-PLAN-SCMV-XXXX.dwg May 23, 2011 - 3:32pm

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Santa Clara Valley Water District

SITE LAYOUT FOR PARTIAL-PROTECTION STRATEGY NEAR THE SANTA CLARA METER VAULT

SCALE
1" = 30'

JOB NO.

FIGURE 4-2

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Table 4-1. Preliminary Design Criteria for the Partial-Protection Strategy for the SBA System

Description	Units	Criteria
Maximum flow rate during potassium addition	cfs	136
Maximum flow rate during potassium addition	mgd	88
Typical winter flow rate	cfs	60
Typical winter flow rate	mgd	39
Assumed potassium dose	mg/L	20
Type of potassium delivered	--	Soluble (dry solid) muriate of potash (KCl)
Maximum daily soluble KCl usage	lbs/day	28,242
Number of silos for soluble KCl	No.	2
Capacity of each silo	pounds	102,000
Silo height	feet	28
Silo diameter	feet	12
Feed solution strength	% potassium	12
Maximum feed solution flow rate	gal/hr	563
Mix tank quantity	No.	2
Volume of each mix tank	gallons	282
Assumed time to complete each batch	minutes	15
Feed tank quantity	No.	2
Volume of each feed tank	gallons	846

Key:
cfs = cubic feet per second
gal/hr = gallons per hour
KCl = potassium chloride
lbs = pound
mg/L = milligrams per liter
mgd = million gallons per day
No. = number

This report presents a chemical storage design for solid potassium chloride because liquid potassium chloride would require four times the storage volume. Alternate potassium storage options may be considered during detailed design to reduce the silo height (if a dry storage design is retained) or to provide liquid chemical storage.

Two silos would be provided at the Santa Clara Meter Vault property for storage of soluble potassium chloride and to contain the mix and feed tanks. The silos will be approximately 28 feet tall and 12 feet in diameter. The silos have been sized to store soluble muriate of potash for 7 days at 136 cubic feet per second (cfs). The bottom of the storage cone will be approximately 16.5 feet above the finished floor to accommodate the screw feeder, mix tank, and feed tank. Stainless steel materials are assumed for the silos, mix tanks, feed tanks, and pipes conveying dry chemicals.

Batches of 25 percent potassium chloride solution will be made in a mix tank from the soluble muriate of potash and on-site chemical carrier water. Upon completion, the batch will be released and flow by gravity to a larger feed tank. Each set of mix and feed tanks have been sized to adequately meet the design capacity. Thus, one silo system (consisting of dry storage, mix tank, and feed tank) could be operated until the chemical storage reaches a minimum value, at which point operations would switch to the other silo system.

Four diaphragm metering pumps will pull from the feed tanks. PVC piping will deliver the solution to an inline mixer installed in the SBA pipeline.

4.2 Cost Estimate for the Partial-Protection Strategy for the SBA System

The following sections present an estimate of project costs, including capital and O&M costs, for the Partial-Protection Strategy for the SBA System.

4.2.1 Opinion of Probable Construction Costs

Table 4-2 presents the Class 5 OPCC for the Partial-Protection Strategy for the SBA System.

Table 4-2. OPCC Summary for the Partial-Protection Strategy for the SBA System

Cost Description	Construction Costs
1. Equipment, Installation/Construction, Startup/Commission	$1,007,000
2. Mobilization/Field Oversight Expenses	$100,700
3. Parametric Contingency (10% of item 1)	$100,700
Subtotal 1	**$1,208,000**
4. Markups and State Sales Tax	$171,605
Subtotal 2	**$1,380,000**
5. Construction Oversight and Management (7% of Subtotal 2)	$97,000
6. Inspection (3% of Subtotal 2)	$41,000
7. Engineering (5% of Subtotal 2 + item 5)	$74,000
8. Permitting (3% of Subtotal 2)	$41,000
9. Administration/Legal Support (5% of Subtotal 2+ item 5+item 7)	$78,000
10. Scope Contingency/Market Conditions (20% of Subtotal 2+item 5+item 7+item 9)	$326,000
Total	**$2,037,000**
Expected Cost Range Per AACE cost estimate guidelines	$1.4 to $3.2 million

Key:
AACE = Association for the Advancement of Cost Engineering
OPCC = opinion of probable construction costs

4.2.2 Estimate of Annual O&M Costs

Table 4-3 presents an estimate of annual O&M costs for the Partial-Protection Strategy for the SBA System.

Table 4-3. Estimate of Annual O&M Costs for the Partial-Protection Strategy for the SBA System

Cost Description	Annual O&M Costs
Chemical costs for potassium (20 mg/L)	$212,000
Maintenance (5% of Equipment Cost)	$50,000
Labor (estimated at 1 FTE)	$100,000
Annual O&M Total	**$362,000**

Key:
FTE = full time equivalent
mg/L = milligrams per liter
O&M = operations and maintenance

4.2.3 Estimate of Total Project Cost

Table 4-4 presents an estimate of total project life cycle costs for the Partial-Protection Strategy for the SBA System.

Table 4-4. Estimated Total Project Life Cycle Costs for the Partial-Protection Strategy for the SBA System

Capital Costs	$2,037,000
5-Year Present Worth Life Cycle Cost (R=5%)	$1,567,000
Total Project Cost (5-Year Present Worth)	**$3,604,000**

Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

Key:
R = Net interest rate

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5.0 Partial-Protection Strategy for the SLR System

As identified in the Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities (MWH, 2011), the recommended Partial-Protection Strategy for the SLR System involves periodic potassium[7] addition at the same location as the Full-Barrier Strategy. This strategy could be used to protect large portions of the raw water system downstream of the injection point, including vulnerable equipment (e.g., systems for pump cooling water or fire suppression). This strategy is still considered to be partially-protective in that it does not protect reservoirs and other water bodies that receive water from the raw water system, and it is not intended to be operated continuously. In many ways, the strategy is similar to Reactive Mitigation Alternative 3 (MWH, 2011), but will be applied on a regular basis as a maintenance practice for vulnerable equipment and other segments of the raw water system. This system could provide a secondary benefit because it offers some mitigation should mussels get into the system downstream of the Full-Barrier Strategy. Potassium would be much more persistent in the raw water system than chlorine dioxide, making it more effective further downstream for killing settled mussels in the raw water infrastructure.

5.1 Conceptual Design for the Partial-Protection Strategy for the SLR System

The Partial-Protection Strategy involves addition of a potassium chloride solution immediately downstream of the upper intake at San Luis Reservoir for a 52-day period each year. The assumed potassium dose is 20 mg/L (pilot testing is recommended to confirm the dose). It is assumed that the pipe and diffuser system for the chlorine dioxide system would be used for this purpose. To reduce the size of the system and annual O&M costs, it is assumed that the potassium addition will occur between the beginning of November and the end of February, when imported water deliveries are typically low.

A process flow diagram for the Partial-Protection Strategy for the SLR System is provided as Figure 5-1. Figure 5-2 shows the site layout for the Partial-Protection Strategy at the Pacheco Pump Plant. Figure 5-3 shows a section view of chemical injection in Pacheco Tunnel Reach 1.

Preliminary design criteria for the Partial-Protection Strategy for the SLR System are presented in Table 5-1.

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[7] Depending on the results of ongoing trials and product availability, Zequanox™ may be a good alternative to potassium and should be considered during detailed design if more product information is available at that time.

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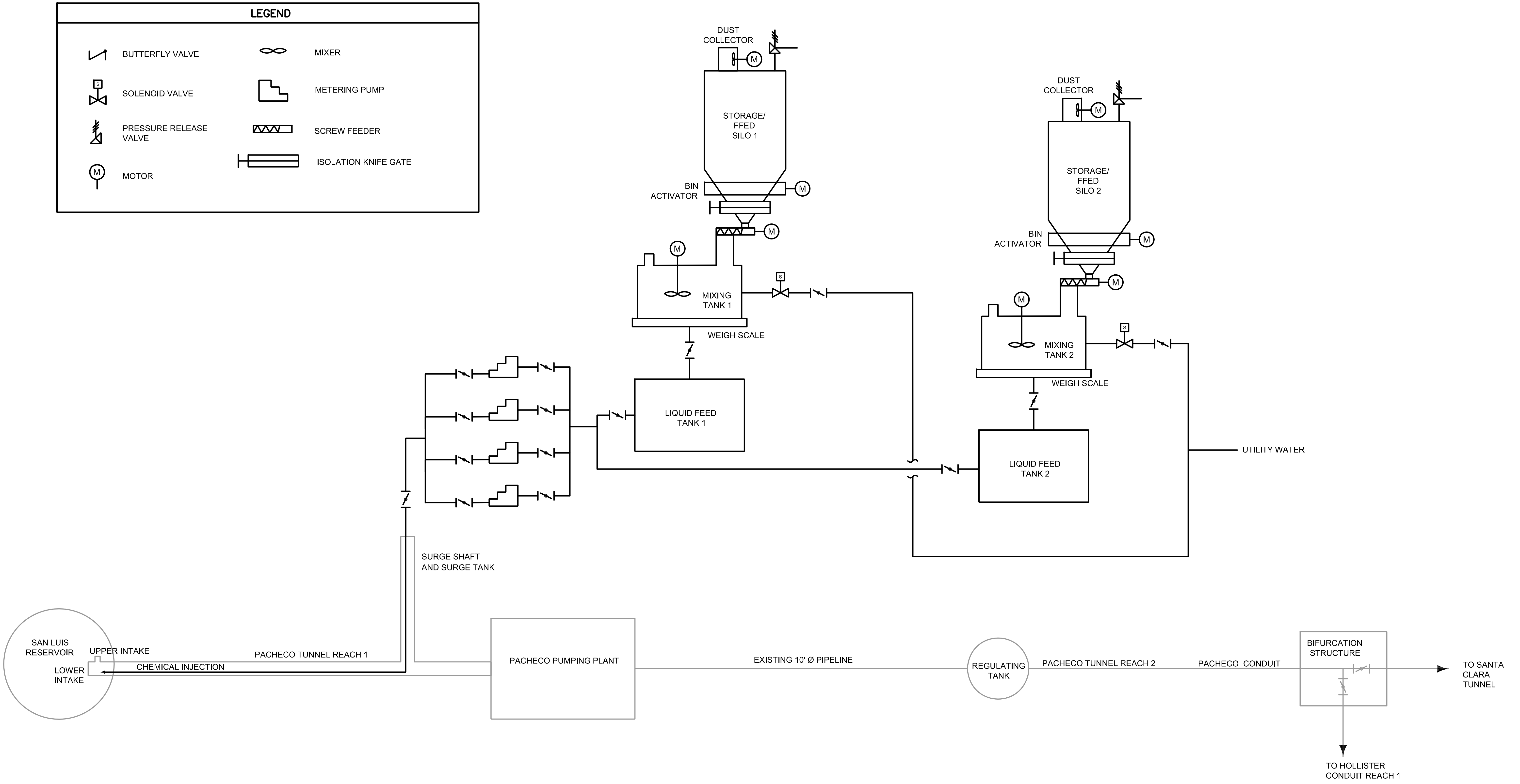

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PROCESS FLOW DIAGRAM FOR PARTIAL-PROTECTION STRATEGY FOR THE SLR SYSTEM

SCALE
NO SCALE

JOB NO.

FIGURE 5–1

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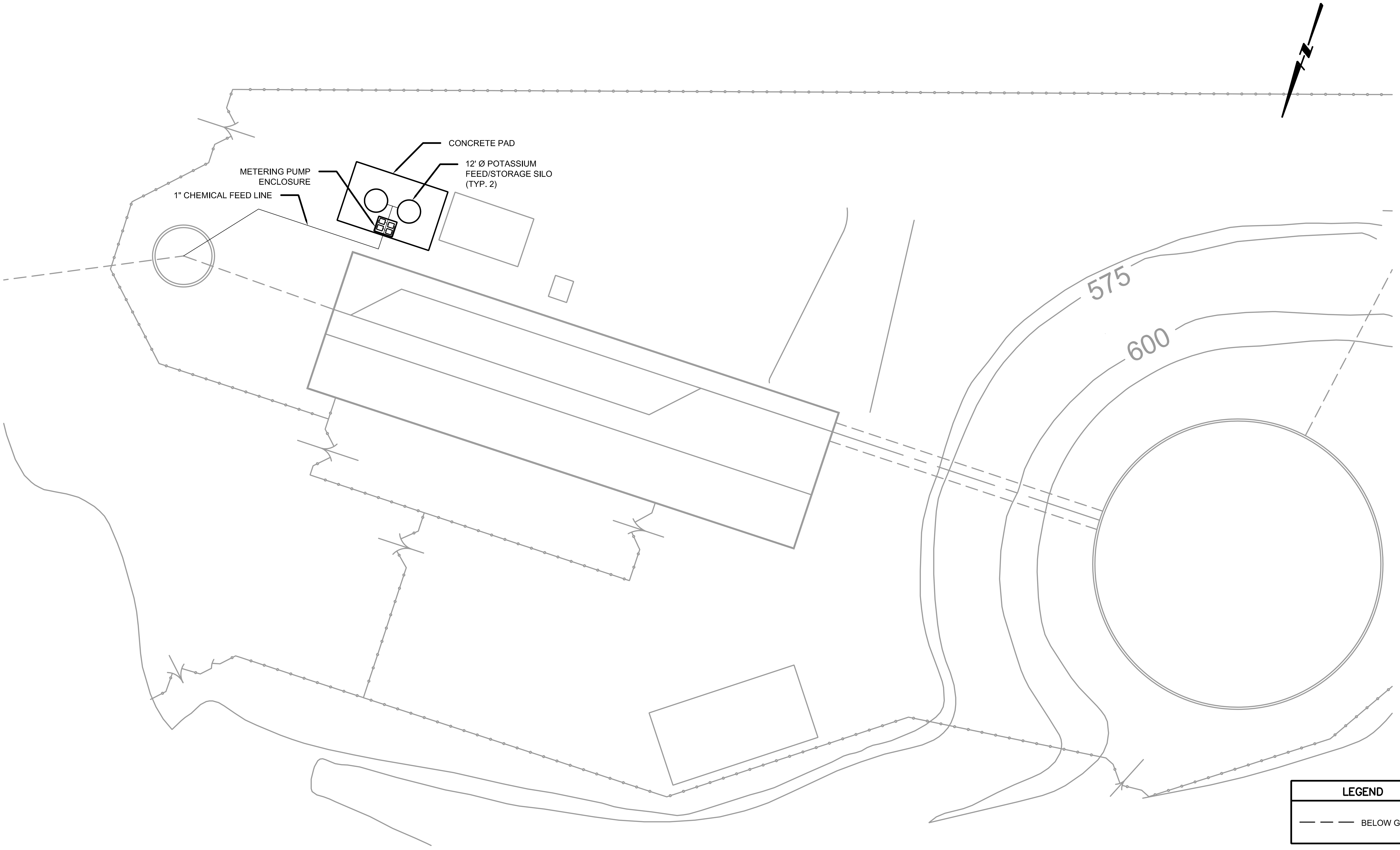

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SITE LAYOUT FOR PARTIAL-PROTECTION STRATEGY AT THE PACHECO PUMP PLANT

SCALE
1" = 50'

JOB NO.

FIGURE 5–2

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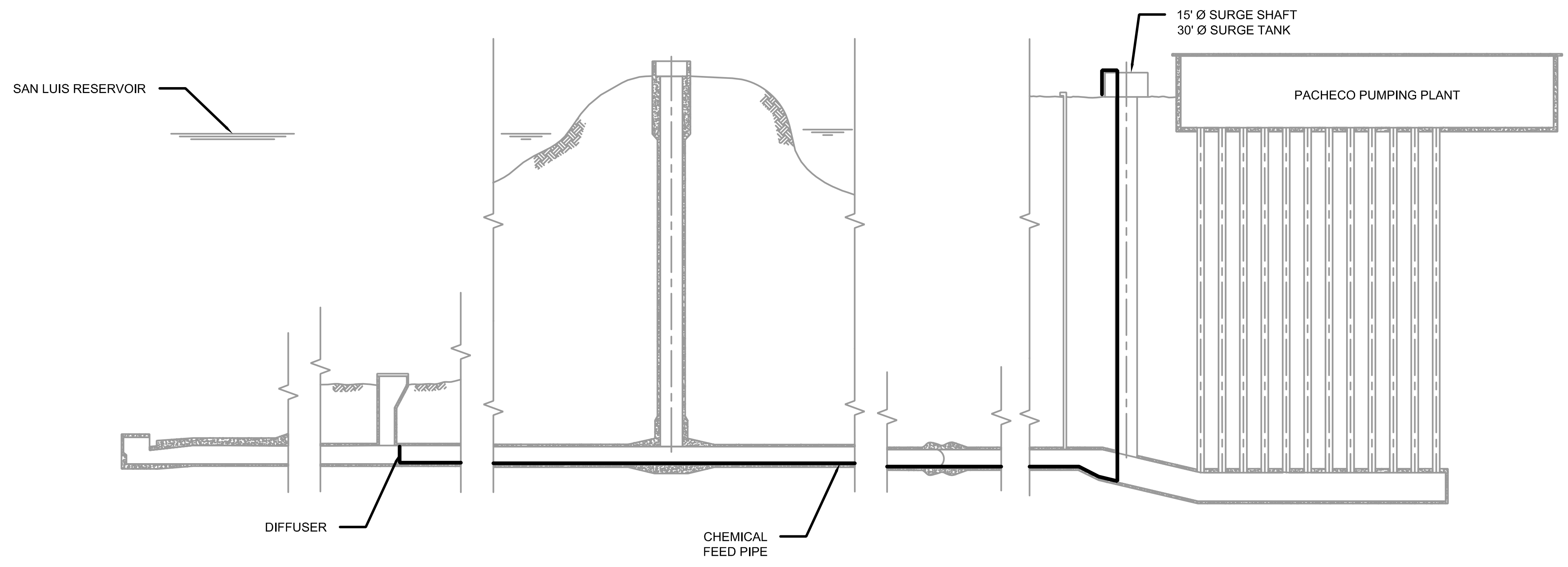

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Santa Clara Valley Water District

SECTION VIEW OF CHEMICAL INJECTION IN PACHECO TUNNEL REACH 1

SCALE
1" = 100'

JOB NO.

FIGURE 5–3

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Table 5-1. Preliminary Design Criteria for the Partial-Protection Strategy for the SLR System

Description	Units	Criteria
Maximum flow rate during potassium addition	cfs	180
Maximum flow rate during potassium addition	mgd	116
Typical winter flow rate	cfs	108
Typical winter flow rate	mgd	70
Assumed potassium dose	mg/L	20
Type of potassium delivered	--	Soluble (dry solid) muriate of potash (KCl)
Maximum daily soluble KCl usage	lbs/day	37,229
Number of silos for soluble KCl	No.	2
Capacity of each silo	pounds	130,000
Silo height	feet	34
Silo diameter	feet	12
Feed solution strength	% potassium	12
Maximum feed solution flow rate	gal/hr	742
Mix tank quantity	No.	2
Volume of each mix tank	gallons	376
Assumed time to complete each batch	minutes	15
Feed tank quantity	No.	2
Volume of each feed tank	gallons	1,163

Key:
cfs = cubic feet per second
gal/hr = gallons per hour
KCl = potassium chloride
lbs = pound
mg/L = milligrams per liter
mgd = million gallons per day
No. = number

This report presents a chemical storage design for solid potassium chloride because liquid potassium chloride would require four times the storage volume. Alternate potassium storage options may be considered during detailed design to reduce the silo height (if a dry storage design is retained) or to provide liquid chemical storage.

Two silos would be provided at the Pacheco Pump Plant for storage of soluble potassium chloride and to contain the mix and feed tanks. The silos will be approximately 34 feet tall and 12 feet in diameter. The silos have been sized to store soluble muriate of potash for 7 days at 180 cfs. The bottom of the storage cone will be approximately 19 feet above the finished floor to accommodate the screw feeder, mix tank, and feed tank. Stainless steel materials are assumed for the silos, mix tanks, feed tanks, and pipes conveying dry chemicals.

Batches of 25 percent potassium chloride solution will be made in a mix tank from the soluble muriate of potash and on-site chemical carrier water. Upon completion, the batch will be released and flow by gravity to a larger feed tank. Each set of mix and feed tanks have been sized to adequately meet the design capacity. Thus, one silo system (consisting of dry storage, mix tank, and feed tank) could be operated until the chemical storage reaches a minimum value, at which point operations would switch to the other silo system.

Four diaphragm metering pumps will pull from the feed tanks. PVC piping will deliver the solution to the surge shaft, where the pipe will connect to a spare pipe to be installed as part of the chlorine dioxide system.

5.2 Cost Estimate for the Partial-Protection Strategy for the SLR System

The following sections present an estimate of project costs, including capital and O&M costs, for the Partial-Protection Strategy for the SLR System.

5.2.1 Opinion of Probable Construction Costs

Table 5-2 presents the Class 5 OPCC for the Partial-Protection Strategy for the SLR System.

Table 5-2. OPCC Summary for the Partial-Protection Strategy for the SLR System

Cost Description	Construction Costs
1. Equipment, Installation/Construction, Startup/Commission	$1,144,000
2. Mobilization/Field Oversight Expenses	$114,400
3. Parametric Contingency (10% of item 1)	$114,400
Subtotal 1	**$1,373,000**
4. Markups and State Sales Tax	$195,000
Subtotal 2	**$1,568,000**
5. Construction Oversight and Management (7% of Subtotal 2)	$110,000
6. Inspection (3% of Subtotal 2)	$47,000
7. Engineering (5% of Subtotal 2 + item 5)	$84,000
8. Permitting (3% of Subtotal 2)	$47,000
9. Administration/Legal Support (5% of Subtotal 2+ item 5+item 7)	$88,000
10. Scope Contingency/Market Conditions (20% of Subtotal 2+item 5+item 7+item 9)	$370,000
Total	**$2,314,000**
Expected Cost Range Per AACE cost estimate guidelines	$1.6 to $3.7 million

Key:
AACE = Association for the Advancement of Cost Engineering
OPCC = opinion of probable construction costs

The total cost does not include pipe and diffusers in the Pacheco Pump Plant Surge Shaft and Pacheco Tunnel Reach 1 because these costs are already included for the chlorine dioxide system.

5.2.2 Estimate of Annual O&M Costs

Table 5-3 presents an estimate of annual O&M costs for the Partial-Protection Strategy for the SLR System.

Table 5-3. Estimate of Annual O&M Costs for the Partial-Protection Strategy for the SLR System

Cost Description	Annual O&M Costs
Chemical costs for potassium (20 mg/L)	$380,000
Maintenance (5% of Equipment Cost)	$57,000
Labor (estimated at 1 FTE)	$100,000
Annual O&M Total	**$537,000**

Key:
FTE = full time equivalent
mg/L = milligrams per liter
O&M = operations and maintenance

5.2.3 Estimate of Total Project Cost

Table 5-4 presents an estimate of total project life cycle costs for the Partial-Protection Strategy for the SLR System.

Table 5-4. Estimated Total Project Life Cycle Costs for the Partial-Protection Strategy for the SLR System

Capital Costs	$2,314,000
5-Year Present Worth Life Cycle Cost (R=5%)	$2,325,000
Total Project Cost (5-Year Present Worth)	**$4,639,000**

Notes:
- These costs are approximate and were developed without detailed designs.
- Net interest rate, R, is assumed to be 5%.

Key:
R = Net interest rate

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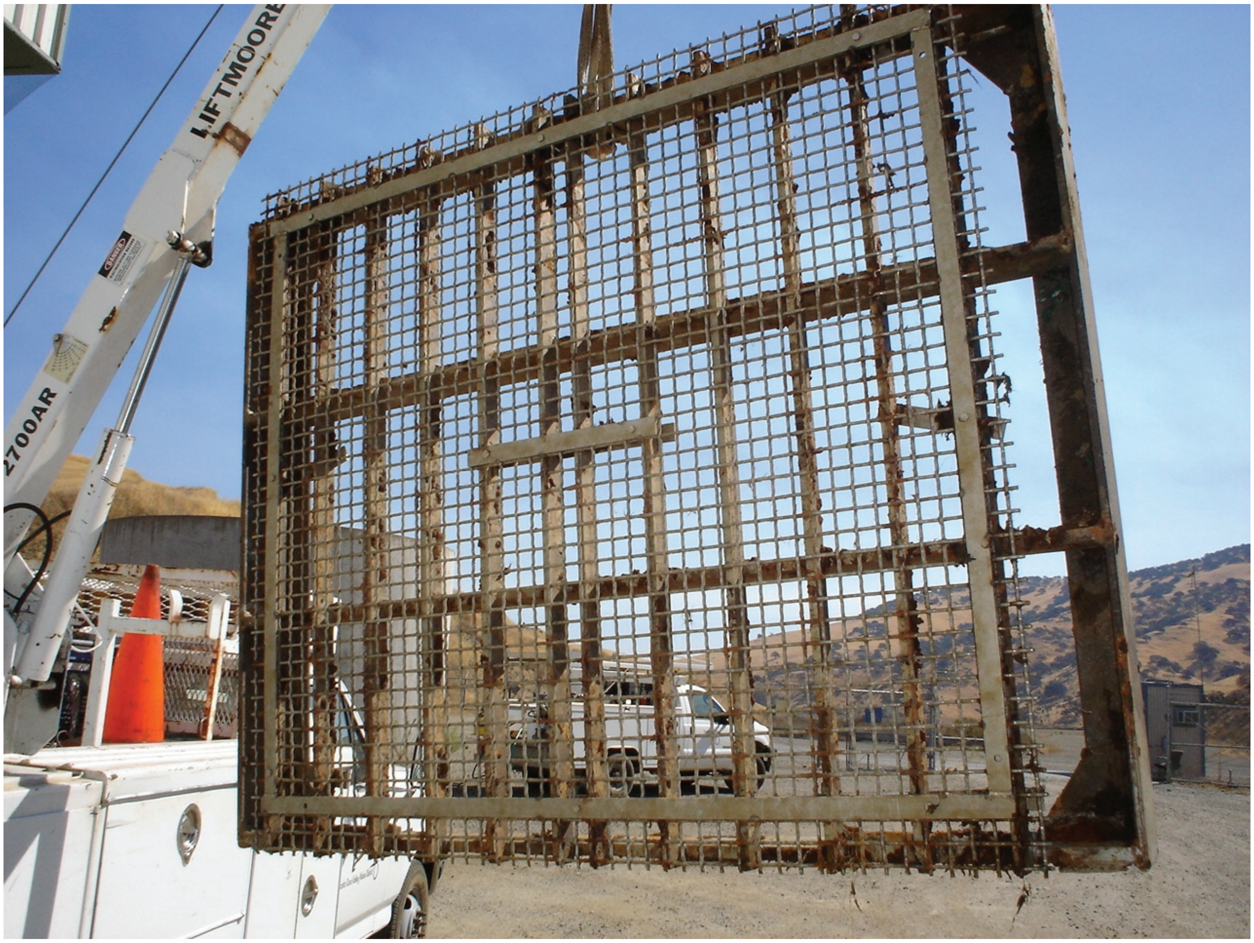
6.0 SLR Intake Trash Racks

The trash racks on the San Luis Reservoir intakes need to be protected from settlement by dreissenid mussels and, because they are upstream of any chemical injection, they will not be protected by the Full-Barrier or Partial-Protection strategies.

Reclamation plan drawings of the upper and lower intakes and the trash racks currently installed on each are included in Appendix I. The 15 existing trash racks are removable, and at least one was removed, inspected, and cleaned in September 2008. Photograph 6-1 shows a trash rack removed from the upper intake during this event. As shown in the photograph, there is stainless steel screen mesh bolted to the outside of the original steel bars.



Photograph 6-1. Trash Rack Temporarily Removed from the Upper Intake in 2008

It is recommended that a new set of 15 trash racks with a biofouling-resistant coating be installed. The new trash racks should be designed with the same dimensions as the existing racks in order to install and remove them easily. The frame and horizontal supports should match the existing racks. While the original vertical bar spacing of 6 inches would be ideal for a mussel-resistant trash rack design, we assume that the mesh screen shown in Photograph 6-1 was installed to protect the Pacheco Tunnel and pumps at the Pacheco Pump Plant from debris that could enter the intake. To minimize flow constriction that could be caused if mussels settle on the trash racks, we recommend discontinuing use of the mesh screen and that the racks be designed with the widest acceptable spacing, up to 6 inches. The trash racks should be designed with lifting eyes to assist in removal.

Silicone foul-release coatings have been tested by Reclamation and shown to require very little force to remove mussels when they are able to attach (Reclamation, 2011). Silicone coatings are less vulnerable to erosion (described as a damage mechanism that can occur from particles in suspension) and more vulnerable to damage by abrasive forces (not described in the memorandum, but tested by using a reciprocating nylon brush impregnated with abrasive particles) than other coatings. Mussels can attach to surfaces in areas where the coating has been damaged (Reclamation, 2011).

For the purposes of the cost estimate in this section, we assume that the 0.625-inch vertical bars will be spaced 3 inches apart to achieve a clear opening of approximately 2.375 inches. Additionally, the entire trash rack should have a silicone-based foul-release coating. For the purposes of the cost estimate in this section, we assume that the coating system will include 2 coats of an epoxy primer (3 to 6 millimeters thick per coat) followed by a top coat of Intersleek 970 silicone coating (5 to 8 millimeters thick).

It is also recommended that the 15 existing trash racks be retrofitted to match the new trash racks (i.e., matching vertical bar spacing, a silicone coating, lifting eyes, and removal of the mesh screen that is currently attached). Following the retrofit, use of the new and existing trash racks could be rotated to allow for more efficient and safer inspection and cleaning at the surface, without lengthy disruptions to operation of the intakes.

Table 6-1 presents the Class 5 OPCC for the SLR intake trash racks.

Table 6-1. OPCC Summary for Replacement and Modifications to the SLR Intake Trash Racks

Cost Description	Construction Costs
1. Equipment and Installation	
Remove 15 existing screens	$110,000
Manufacturing and installation of 15 new screens	$460,000
Retrofit 15 existing screens with additional bars and coating	$80,000
Subtotal 1	**$650,000**
2. Mobilization/Field Oversight Expenses	$65,000
3. Parametric Contingency (5% of item 1)	$32,500
4. Markups and State Sales Tax	$138,000
Subtotal 2	**$886,000**
5. Construction Oversight and Management (2% of Subtotal 2)	$18,000
6. Inspection (2% of Subtotal 2)	$18,000
7. Engineering (5% of Subtotal 2 + item 5)	$45,000
8. Permitting (1% of Subtotal 2)	$9,000
9. Administration/Legal Support (5% of Subtotal 2+ item 5+item 7)	$47,000
10. Scope Contingency/Market Conditions (5% of Subtotal 2+item 5+item 7+item 9)	$50,000
Total	**$1,073,000**
Expected Cost Range Per AACE cost estimate guidelines	$0.7 to $1.7 million

Key:
AACE = Association for the Advancement of Cost Engineering
OPCC = opinion of probable construction costs

The equipment and installation costs include:

- Fabrication of new trash racks as described above.
- Modifying the existing racks by cleaning, adding additional vertical bars to achieve the required 3-inch spacing, and coating with foul-resisting silicone.
- Removing and installing the trash racks by divers

A barge-mounted crane to assist in removal and installation is not included in the costs above, as this may be performed in coordination with installation of the chemical piping in Pacheco Tunnel.

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7.0 Next Steps

This section briefly describes some of the next steps needed to advance the Invasive Mussel Control Measures at Imported Water Intakes Project.

7.1 Continue Proactive Measures

The District should continue the proactive measures that are in place to keep invasive mussels out of its reservoirs. The District will not be able to discontinue boat inspections, as its reservoirs are still vulnerable to mussel infestations even if the Full-Barrier or Partial-Protection strategies are implemented. The District's routine dreissenid mussel monitoring program is important for providing early detection of mussels if they arrive in imported source water or District water bodies and operating the strategies described in this report. If mussels do become established, the monitoring program will continue to be valuable for making operational decisions by providing information such as the geographical and temporal changes in mussel populations.

7.2 Bench Scale Testing

Bench scale testing is recommended to confirm the demand and decay of chlorine dioxide over a range of water quality conditions for each imported water source.

Taste tests, using finished water with a range of concentrations of potassium, are recommended to help the District define upper limits of acceptable potassium concentrations.

7.3 Pilot Testing

Pilot testing is a critical step toward implementation of a Full-Barrier Strategy. Testing should include the necessary dose and contact time for chlorine dioxide to kill 100 percent of mussel veligers. It is recommended that similar testing with ferrate[8] be performed in parallel in case the necessary chlorine dioxide dose is prohibitively high.

It is also recommended that a test be performed that simulates the anticipated conditions under which the Partial-Protection Strategy would be operated (e.g., the effect of 20 mg/L potassium for 52 days on settled mussels in a flow-through environment) to confirm dose and duration.

We recommend piloting at San Justo Reservoir before eradication efforts take place and during a time of year when mussel larvae are prevalent (most likely from April through November). DWR will reportedly be running a test of low pH effects in July and August 2011. The flow-through system may be available for other testing by September, but relying on this option could possibly limit the duration of testing and leave questions unanswered. Without the details of the system, it is not certain that it will be compatible for the testing that the District desires. The District may be better served by moving forward with separate plans for testing.

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[8] The design of a full-scale ferrate system should be similar in many respects to the chlorine dioxide system.

An additional consideration to address during pilot testing is whether the chemicals being tested could have effects on pipe lining and/or joints.

7.4 Develop Estimates of Costs Incurred Under Minimal or No Protection Scenarios

The costs that may be incurred by the District are not known at this time for a scenario in which no control methods are implemented and mussels infest imported source water supplies. An estimate of these costs over 25 years should be developed for the purpose of comparing to the life cycle costs of the Full-Barrier Strategy. The costs of minimal control methods, possibly paired with reactive mitigation measures, should also be developed.

7.5 Detailed Design of the Full-Barrier Strategy

The detailed design of the Full-Barrier Strategy should commence once pilot testing confirms a viable Full-Barrier Strategy and the advantages of such a system are shown to outweigh less protective strategies.

7.6 Design and Construction of the Partial-Protection Strategy

In order to minimize the negative consequences that could occur if the District’s source water becomes infested with mussels before the Full-Barrier Strategy is operational, it is recommended that the District design and construct the Partial-Protection Strategy. Operation of the Partial-Protection Strategy is not recommended unless mussels become established in imported source water or the District’s raw water system prior to implementation of the Full-Barrier Strategy.

7.7 Coordination with Regulatory Agencies

As described in Sections 2.1.2 and 3.1.2, coordination with regulatory agencies will be necessary to discharge clarified backwash water and screw press filtrate to Calera Creek and San Luis Reservoir.

Prior to or during design of the Partial-Protection Strategy, discussions with regulatory agencies should be initiated to resolve the following issues:

- Products used as an aquatic pesticide must be listed as such. Despite the fact that potassium has been used to control or eradicate invasive mussels in the United States, no known potassium chloride products are listed with the United States Environmental Protection Agency as a biocide.

- Potassium has similar effects for native mollusks as it does for invasive mussels. Discussions with the appropriate agencies are necessary to determine whether there might be restrictions on the discharge of water containing 20 mg/L potassium to reservoirs, percolation ponds, or creeks.
- NSF 60 certification of the potassium chloride supply may be desired and/or necessary.

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8.0 References

MWH, 2011. Feasibility Study of Invasive Mussel Control Measures for Imported Water Facilities. July.

RNT Consulting, Inc. (RNT), 2010. Vulnerability of Santa Clara Valley Water District Imported Water Facilities and Potential Impacts from Invasive Dreissenid Mussels. September 24.

U.S. Department of the Interior, Bureau of Reclamation, (Reclamation) 2011. 30 months update on Coatings for Mussel Control at Parker Dam. Memorandum. February 2.

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APPENDIX A
Dupont Chlorine Dioxide Generation Equipment Proposal

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ClO$_2$ GENERATION EQUIPMENT PROPOSAL

for

SANTA CLARA VALLEY WATER DISTRICT

For the supply of Engineering, Technical Services and Equipment for a

CHLORINE DIOXIDE GENERATION SYSTEMS

Submitted by:

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February 23, 2011

CONTENTS

EXECUTIVE SUMMARY

SECTION ONE: INTRODUCTION

1.1 IDI-DUPONT ClO_2 SYSTEM EQUIPMENT DESCRIPTIONS
1.2 ClO_2 GENERATOR CONTROLS PHILOSOPHY

SECTION TWO: ClO_2 SYSTEM DESIGN

2.1 SCVWD DESIGN CRITERIA
2.2 ESTIMATED OPERATING COSTS

SECTION THREE: ClO_2 SYSTEM EQUIPMENT

3.1 ClO_2 GENERATOR HARDWARE
3.2 ClO_2 SYSTEM - HARDWIRED PLC I/O EQUIPMENT LIST

SECTION FOUR: ClO_2 SYSTEM PRICING

4.1 ClO_2 GENERATOR SYSTEM COST

APPENDICES:

APPENDIX A: IDI-DuPont One Year Limited Warranty
APPENDIX B: IDI-DuPont Standard Terms & Conditions
APPENDIX C: P&ID DRAWING(S) (Typical)

EXECUTIVE SUMMARY

International Dioxcide, Inc. - DuPont® Water Technologies (IDI-DuPont®) is pleased to submit this Chlorine Dioxide (ClO_2) Equipment Proposal to the Santa Clara Valley Water District (SCVWD) for the supply of two (2) separate chlorine dioxide generator systems to treat raw water supplies for SCVWD.

One of the ClO_2 generators will be installed at the Pacheco Pumping Plant and the other on the South Bay Aqueduct raw water supply. These new ClO_2 systems will be used on a flow-paced, direct injection basis to treat raw drinking water to control the larval stages of quagga and zebra mussels.

The ClO_2 generation systems will be capable of producing the following pounds per day of ClO_2 based on the respective raw water flow rates and dosing documented in the table below:

ClO_2 Generator Location	Flow Rate (MGD)	ClO_2 Dose (mg/L)	Daily ClO_2 Required (Pounds per Day)
South Bay Aqueduct	55 (Avg)	1.4	650
	120 (Peak)	1.4	1,400
Pacheco Pumping Plant	145 (Avg)	1.4	1,700
	310 (Peak)	1.4	3,600

The ClO_2 systems to be supplied will be identical IDI-DuPont® 2 inch diameter custom-engineered chlorine dioxide (ClO_2) OXYCHLOR® MG III Series 3-part generators that use: 25% / 31% sodium chlorite ($NaClO_2$), 12.5% sodium hypochlorite (NaOCl) and 15% hydrochloric acid (HCl) to produce the ClO_2 on site, as required.

Duplex motive water booster pumps will be provided to maintain the inlet flow to the generator eductors at a maximum of 106 USGPM and minimum 100 psi. The 100 psi water pressure is required to overcome the 40-60 psi pressure drop (loss) across the eductor and headlosses in the injection line. ClO_2 will be injected into the flow stream via a submerged header arrangement.

The concentration of the chlorine dioxide will be set by the operator at the ClO_2 system PLC HMI to a concentration of up to 3,000 ppm as measured by an Optek® optical ClO_2 concentration analyzer. The optional flow-pacing controller included will then vary the ClO_2 volume going to the injection point to accommodate changes in the process water flow rate, the actual ClO_2 concentration and the desired ClO_2 dose.

The associated SCADA communications protocol will be the Modicon® Modbus Plus protocol and each generator will have its own Modicon Quantum™-series PLC and a color Telemecanique Magelis® HMI. The PLC will communicate via Modbus Plus to the SCADA system and provide all ClO_2 system PLC data to the SCADA system without need for further wiring.

IDI-DuPont Water Technologies has over twenty-five (25) years experience in the application of chlorine dioxide and sodium chlorite technologies for the solution of diverse water and wastewater treatment challenges. With over 500 ClO_2 systems installed worldwide DuPont Water Technologies has proven solutions using ClO_2 technology designed with a focus on safety, reliability and simplicity of operation.

SECTION ONE: INTRODUCTION

1.1 IDI-DUPONT ClO_2 SYSTEM EQUIPMENT

DESCRIPTIONS OXYCHLOR® MG-III GENERATOR

The OXYCHLOR® MG-III Chlorine Dioxide Generator is designed to generate a maximum of 5,000 pounds per day (ppd) of a chlorine dioxide solution on a sustained basis. The IDI-DuPont OXYCHLOR® MG-III produces chlorine dioxide solution via the reaction between 25% Sodium Chlorite (NaClO2), 12.5% Sodium Hypochlorite (NaOCl) and the 15% Hydrochloric Acid (HCl) according to the reaction:

$$2\,NaClO_2 + NaOCl + HCl \longrightarrow 2\,ClO_2 + 2NaCl + H_2O$$

The OXYCHLOR® MG Series generator(s) produce chlorine dioxide as a saturated solution via an inherently safe process. The use of a vacuum eductor allows precursor chemical flow only when there is sufficient motive water flow through the eductor to produce a vacuum. The vacuum formed by the motive water causes the chemicals to flow and mix at the point where the vacuum is formed. The chemicals react instantaneously forming chlorine dioxide solution.

In addition, the chlorine dioxide is immediately diluted to a concentration typically at or, below 3,000 mg/L; preventing the formation of potentially high concentrations of chlorine dioxide inside the generator.

The OXYCHLOR® generator, is controlled via a Programmable Logic Controller (PLC). The PLC program provides all the information, control and safety monitoring to ensure the safe and reliable generation of the ClO_2 solution.

Within the generator process, several safety devices monitor water flow, chemical flow and pH. The whole system is skid-mounted and is composed of several function-specific equipment modules for ease of installation, testing, maintenance and operation.

Automatic control valves and flow meters are used on the precursor chemicals to facilitate the stoichiometric mixing of the precursor chemicals in their correct proportions based on the plant flow and desired ClO_2 dose rate.

The stoichiometric mixing of the precursors is also optimized via a process that DuPont had obtained an earlier patent on whereby the pH of the reaction is controlled such that reaction efficiencies in excess of

95% can be realized. This process also minimizes the amount of un-reacted Cl_2 gas that can go into the treatment stream.

IDI-DuPont ClO_2 Generator Systems include the following features:

Water Feed Features:

- Pressure Gauge – Provides inlet process water feed pressure indication
- Electronic Actuated Control Valve - Controls flow of water to the generator
- Flow Switch – Safety device shuts down generator on loss of feed water
- Vacuum Eductor – Part of the inherently safe generator design philosophy - uses motive force of water to draw precursor chemicals under vacuum
- Motive Water Booster Pump – Is used to maintain the 40 – 60 PSI differential across the ClO_2 generator's eductor and provide sufficient pressure to overcome the backpressure at point of injection (N/A)

Solution Feed Features:

- Double-walled Sight Glass, to observe ClO_2 "color" – provides quick relative indication of ClO_2 concentration being produced
- pH Monitor, enables operators to perform a rapid visual check whether ClO_2 generation is in the optimal range established by the PID controller

Chemical Feed Features:

- Rotameters – Provide visual display of precursor chemical flows and manual adjustment of flow rates
- Isolation Solenoids – Fail-safe device to stop precursor chemical flow
- Isolation Manual Valves - Safety devices to isolate precursor chemical feeds
- Check Valves - Safety device to prevent chemical flow back to bulk storage
- Automatic Control Valves - Modulate sodium chlorite and anhydrous chlorine flow rates based on plant flow and desired ClO_2 dose
- Magnetic Flow Meter – Accurately measures sodium chlorite feed

PLC Control Panel Features:

- Patented (formerly) pH control system
- Operator interface with lights and switches
- Comprehensive alarms
- PLC controller integrated with plant SCADA system
- NEMA 4X electrical enclosures
- Various electrical interlocks for Generator equipment
- Alarm logging

ClO_2 Injection System Features:

- Automatic Flow-Pacing System – Controlled via the Generator PLC based on a plant 4-20mA flow signal, the ClO_2 concentration as measured by the Optek® ClO_2 concentration analyzer and the desired ClO_2 dose level as entered at the PLC (or, SCADA) by the Operator

General:

- Extensive use of union connections for easy installation and maintenance
- All piping is CPVC Schedule 80 and all tubing is fluorinated ethylene propylene (FEP)
- Use of quality materials throughout
- Stainless Steel skid/panel-mounted

1.2 ClO_2 GENERATOR CONTROLS PHILOSOPHY

GENERATOR CONTROL

The system PLC will initiate and control all aspects of generator activity including system flow pacing and ClO_2 dosing.

When the generator start request is energized, the electric ball valve will open; After a fixed period of time the booster pump contactor will be energized. Then the sodium chlorite and hydrochloric acid and sodium hypochlorite solenoid valves will open.

The automatic flow-pacing system valves will be set to a predetermined flow of sodium chlorite, sodium hypochlorite and hydrochloric acid. Once a value has been determined by the PLC these valves will be maintained and need not be changed unless there is a larger or lesser ClO2 requirement or, slippage of the meter indicator is observed.

The PLC system shall automatically vary ClO_2 output with the process flow rate. The precursor chemicals shall be drawn into the OXYCHLOR MG -III Chlorine Dioxide Generating System under vacuum, reacted into chlorine dioxide solution and delivered to the point of injection.

The generator reaction shall be capable of maintaining a minimum efficiency of 95 percent chlorine dioxide from the reaction of the three precursor chemicals.

The generator will utilize a vacuum to draw chemical precursors into the Oxychlor MG III Chlorine Dioxide Generating System. A pH meter will be included in the generator effluent line to monitor the generator effluent pH and to provide alarm status for feed rate imbalance and to minimize the un-reacted chlorite in the ClO_2 injection stream.

SHUTDOWN ALARM CONDITIONS

Emergency Stop Button (ESB). If depressed this will shut down the generator, by closing water and chemical solenoids and closing the water electric ball valves. Operator acknowledgement and reset of the ESB will be required before restart.

Other alarm conditions requiring generator shutdown include:

1. Carrier water flow (Loss)
2. Carrier water EBV failure
3. pH High/Low

OPERATOR ALERT ALARMS (Will not shut down the generator)

Chlorine dioxide flow meter indicates LOW ClO_2 flow. In event of failure of the motive water pump or pump valving the CLO_2 dosing will not occur and this alarm will alert the operator that CLO_2 is potentially not being dosed correctly.

Optek® analyzer indicates LOW ClO_2 concentration. In event of improper ClO_2 production, CLO_2 concentration may be low, CLO_2 dosing would not be correct and the operator would be alerted. LOW ClO_2 concentration indication may also mean that the Optek® sensor needs to be cleaned.

SCADA INTERFACING

The PLC will have the ability to communicate with the plant SCADA over Modbus Plus protocol. The PLC will be a Modicon Quantum™-series PLC with a Telemecanique Magelis® color graphics terminal human machine interface (HMI).

PLC Screen Display

Main Screen

Plant Flow Display in MGD units

Indication of that any of the alarms are active

Buttons to move to other screens. Indication of which alarms are active.

pH Reading

Note: This is a generic listing – actual screen data may vary

ClO_2 DOSING INTEGRITY

To ensure the integrity of the ClO_2 dosing the PLC will calculate the required volume of ClO_2 solution required for injection in real time by looking at the plant flow signal, the required ClO_2 dose input, the flow of ClO_2 solution at the injection point and the ClO_2 concentration at the injection point provided by the Optek® analyzer.

SECTION TWO: ClO_2 SYSTEM DESIGN

2.1 SCVWD DESIGN CRITERIA

SOUTH BAY AQUEDUCT

Max Process Flow	120 MGD
Nominal/Average Process Flow	55 MGD
Maximum ClO_2 Dosage	1.4 ppm
ClO_2 Generator Concentration	2,500 ppm – 3,000 ppm
Water Type	Raw Water
Nominal Water Temperature	22 degrees C
Motive Water Initial Feed Pressure	~40 psig
Back Pressure at Injection Point	<20 psig (assumed)
Precursor Chemical Storage Location	<50 feet from generator at same elevation
Electrical Service	110V / 1 phase for all pump(s)
Influent Flow Meter	4-20 mA signal to ClO_2 Generator PLC provided by SCADA
ClO_2 Dose (mg/L)	PLC / SCADA input by SCVWD Operators
Generator ON / OFF Operation	Signals provided by ClO_2 Generator PLC
pH of ClO_2 Solution	Output Value from pH Sensor
Precursor Chemical(s) Flow Rate	Output Value from ClO_2 Generator PLC
ClO_2 Generator System Fault(s)	Output (discreet) ClO_2 Generator PLC
ClO_2 Generator PLC Alarms	pH, Chemical Flow, Water Flow, E-stop
ClO_2 Concentration (ppm)	Optek Analyzer (Qty - 1)

2.1 DESIGN CRITERIA – Cont'd.

PACHECO PUMPING PLANT

Max Process Flow	310 MGD
Nominal/Average Process Flow	145 MGD
Maximum ClO_2 Dosage	1.4 ppm
ClO_2 Generator Concentration	2,500 ppm – 3,000 ppm
Water Type	Raw Water
Nominal Water Temperature	22 degrees C
Motive Water Initial Feed Pressure	~40 psig
Back Pressure at Injection Point	<20 psig (assumed)
Precursor Chemical Storage Location	<50 feet from generator at same elevation
Electrical Service	110V / 1 phase for all pump(s)
Influent Flow Meter	4-20 mA signal to ClO_2 Generator PLC provided by SCADA
ClO_2 Dose (mg/L)	PLC / SCADA input by SCVWD Operators
Generator ON / OFF Operation	Signals provided by ClO_2 Generator PLC
pH of ClO_2 Solution	Output Value from pH Sensor
Precursor Chemical(s) Flow Rate	Output Value from ClO_2 Generator PLC
ClO_2 Generator System Fault(s)	Output (discreet) ClO_2 Generator PLC
ClO_2 Generator PLC Alarms	pH, Chemical Flow, Water Flow, E-stop
ClO_2 Concentration (ppm)	Optek Analyzer (Qty - 1)

2.2 ESTIMATED OPERATING COSTS

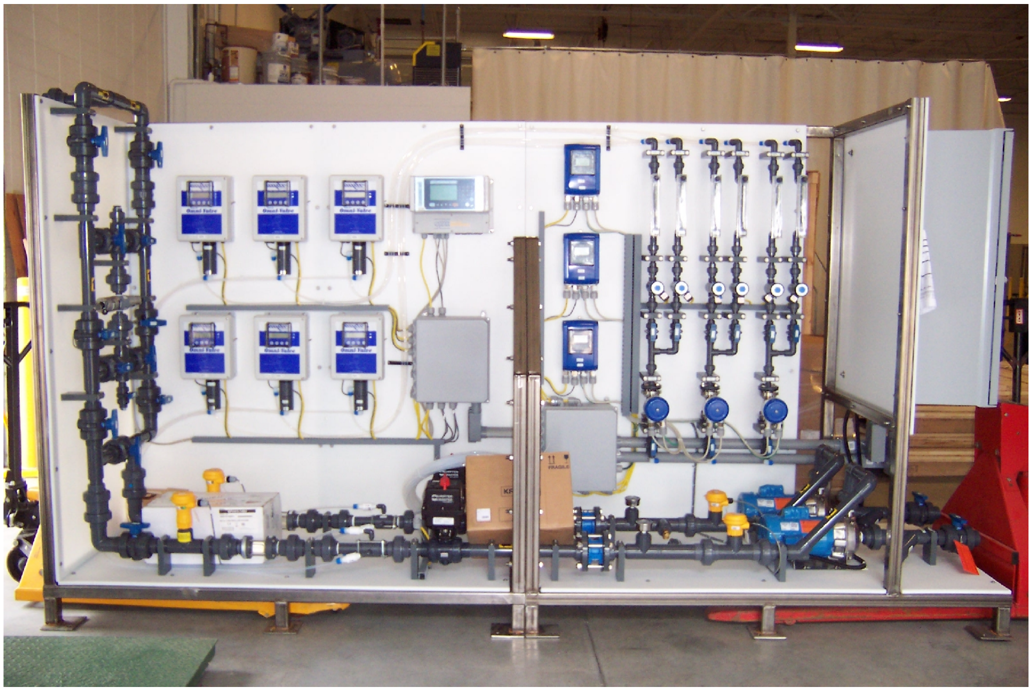
The table below documents the approximate pound-per-day quantities of ClO_2 required based on various flows and a 1.4 ppm ClO_2 dose:

ClO_2 Generator Location	Flow Rate (MGD)	ClO_2 Dose (mg/L)	Daily ClO_2 Required (Pounds per Day)
South Bay Aqueduct	55 (Avg)	1.4	650
	120 (Peak)	1.4	1,400
Pacheco Pumping Plant	145 (Avg)	1.4	1,700
	310 (Peak)	1.4	3,600

ClO_2 GENERATOR CHEMICALS

The OXYCHLOR® MG III system requires three (3) chemical solution inputs to produce ClO_2 for injection. For each pound (lb) of ClO_2 generated the following amounts of precursors are required:

- 4.33 lbs of 31% Sodium Chlorite ($NaClO_2$)
- 4.95 lbs of 12.5% Sodium Hypochlorite ($NaOCl$)
- 3.60 lbs of 15% Hydrochloric Acid (HCl)



Skid-Mounted OXYCHLOR® MG III ClO_2 Generator w. Booster Pump (Unit shown is fully redundant)

SOUTH BAY AQUEDUCT

Table 1: Daily Chemical Costs at **55 MGD**

Chemical Precursor	Supplier	Qty/Day (lbs)	Cost/lb ($USD)	Cost/Day ($USD)
NaClO2 (31%)	IDI-DuPont(1)	2,781	$0.61	$1,696
NaOCl (12.5%)	Chemical Supplier (2)	3,179	$0.105	$334
HCl (15%)	Chemical Supplier (2)	2,312	$0.106	$245
			TOTALS	$2,275

Notes (1): **DuPont price to SCVWD is $0.61/lb Bulk, Delivered.**
Subject to change based on raw material price increases.
(2): **BCS pricing is Bulk, Delivered.**

Table 2: Daily Chemical Costs at **120 MGD**

Chemical Precursor	Supplier	Qty/Day (lbs)	Cost/lb ($USD)	Cost/Day ($USD)
NaClO2 (31%)	IDI-DuPont(1)	6,067	$0.61	$3,701
NaOCl (12.5%)	Chemical Supplier (2)	6,936	$0.105	$728
HCl (15%)	Chemical Supplier (2)	5,044	$0.106	$535
			TOTALS	$4,964

Notes (1): **DuPont price to SCVWD is $0.61/lb Bulk, Delivered.**
Subject to change based on raw material price increases.
(2): **BCS pricing is Bulk, Delivered.**

Table 3: Daily Chemical Costs at **145 MGD**

Chemical Precursor	Supplier	Qty/Day (lbs)	Cost/lb ($USD)	Cost/Day ($USD)
NaClO2 (31%)	IDI-DuPont(1)	7,331	$0.61	$4,472
NaOCl (12.5%)	Chemical Supplier (2)	8,380	$0.105	$880
HCl (15%)	Chemical Supplier (2)	6,095	$0.106	$646
			TOTALS	$5,998

Notes (1): DuPont price to SCVWD is $0.61/lb Bulk, Delivered.
Subject to change based on raw material price increases.
(2): BCS pricing is Bulk, Delivered.

Table 4: Daily Chemical Costs at **310 MGD**

Chemical Precursor	Supplier	Qty/Day (lbs)	Cost/lb ($USD)	Cost/Day ($USD)
NaClO2 (31%)	IDI-DuPont(1)	15,673	$0.61	$9,561
NaOCl (12.5%)	Chemical Supplier (2)	17,917	$0.105	$1,881
HCl (15%)	Chemical Supplier (2)	13,030	$0.106	$1,381
			TOTALS	$12,823

Notes (1): DuPont price to SCVWD is $0.61/lb Bulk, Delivered.
Subject to change based on raw material price increases.
(2): BCS pricing is Bulk, Delivered.

3.1 ClO_2 GENERATOR HARDWARE

The DuPont® OXYCHLOR® MG III technology offers simple operation and represents a significantly safer working environment for ClO_2 generator operators and maintenance personnel than competitor's systems on the market today.

IDI-DuPont will ship to SCVWD two (2) new units each configured with a 2 inch diameter, 5,000 ppd OXYCHLOR® MG III ClO_2 Generator Module, a Duplex Water Booster Pump VFD Module and Flow-Pacing Control Module along with a single Optek® ClO_2 Concentration Module controlled by a Modicon Quantum™-series PLC and a color Telemecanique Magelis® HMI as described herein. The individual equipment modules and spare parts to be provided under this Proposal are described in the following three (3) Tables below.

ClO_2 EQUIPMENT MODULE SCHEDULE

EQUIPMENT MODULES	QTY
Generator Module	2
Duplex Booster Pump Module w. VFD	2+2
Precursor Chemical Feed Module	2
Flow Pace Module	2
Optek® ClO_2 Concentration Module	2
PLC Panel & PLC Programming	2

ClO_2 EQUIPMENT SPARES SCHEDULE

EQUIPMENT SPARES	QTY
Booster Pump	2
Eductor	2

ClO_2 GENERATOR STANDARD SPARE PARTS SCHEDULE

GENERATOR SPARES	QTY
½ Plastomatic Solenoid EASYMT	2
¾" Ball Valve	2
½" Ball Valve	2
1" Plastomatic Ball Valve	2
P.M Kit 1-1/4 Eductor	2
¼ Parker Check Valve	2
pH Probe	2
1/4" FEP Tubing	40 Ft
Meter 74GPD sg 1.21 PVC King	2

3.2 ClO_2 System - Hardwired PLC I/O Equipment List

(Typical for each ClO_2 Generator)

ANALOG INPUTS	**EQUIPMENT**
Raw Water Flow Meter (4-20 mA)	**SCADA***
Operator Input – ClO2 Dose (4-20 mA)	**PLC/SCADA***
pH Monitor (4-20 mA)	**AT1302**
Optek Analyzer – Injection Point ClO2 (4-20 mA)	**AT1605**
Motive Water Flow Meter Generator (4-20 mA)	**FT1210**
Sodium Chlorite Flow Meter Generator (4-20 mA)	**FT1301**
ClO_2 Flow Meter at Injection Point (4-20 mA)	**FT 1609**
Sodium Chlorite Flow Control Valve Position (4-20 mA)	**FCV 1201**
Sodium Hypochlorite Flow Control Valve Position (4-20 mA)	**FCV 1202**
Hydrochloric Acid Flow Control Valve Position (4-20 mA)	**FCV 1203**
ANALOG OUTPUTS	**EQUIPMENT**
Sodium Chlorite Flow Control Valve Control (4-20 mA)	**FCV 1302**
Sodium Hypochlorite Flow Control Valve Control (4-20 mA)	**FCV 1303**
Hydrochloric Acid Flow Control Valve Control (4-20 mA)	**FCV 1304**
Motive Water Booster Pump #1 VFD Control (4-20mA)	**P1002**
Motive Water Booster Pump #2 VFD Control (4-20mA)	**P1003**
DIGITAL INPUTS	**EQUIPMENT**
Electric Ball Valve Limit Switch Status #1(OPEN / CLOSED)	**EBV1205**
Motive Water Pump Relay Contacts Status Pump #1(ON / OFF)	**P1002**
Electric Ball Valve Limit Switch Status #2(OPEN / CLOSED)	**EBV1206**
Motive Water Pump Relay Contacts Status Pump#2(ON / OFF)	**P1003**
E-Stop Button	**TBD**
DIGITAL OUTPUTS	**EQUIPMENT**
Motive Water Pump Relay #1(START / STOP)	**P1002**
Motive Water Pump Relay #2(START / STOP)	**P1003**
Electric Ball Valve Limit Control #1(OPEN / CLOSED)	**EBV1205**
Electric Ball Valve Limit Control #2(OPEN / CLOSED)	**EBV1206**
Sodium Chlorite Feed Valve (OPEN / CLOSED)	**SV1201**
Sodium Hypochlorite Feed Valve (OPEN / CLOSED)	**SV1202**
Hydrochloric Acid Feed Valve (OPEN / CLOSED)	**SV1203**

* *PLC I/O points are software inputs from the local PLC HMI panel or the plant's SCADA system.*

SECTION FOUR: ClO_2 SYSTEM PRICING

4.1 ClO_2 GENERATOR SYSTEM COST

SOUTH BAY AQUEDUCT

- **$156,600 USD** plus applicable taxes, FOB Jobsite

PACHECO PUMPING PLANT

- **$156,600 USD** plus applicable taxes, FOB Jobsite

Notes:

Price includes the ClO_2 generator system equipment, spare parts, PLC and other equipment described herein. Price includes shipping to the SCVWD sites of all equipment and materials required for the ClO_2 generator system, its installation and other items described herein. Price includes programming of the PLC, but does not include programming of the SCVWD SCADA system.

Price includes complete design of the ClO_2 generator system, system P&ID drawings and Operation & Maintenance manuals for the systems and its parts. Price also includes three (3) days installation and two (2) days start-up/training (based on a full 8 hour day) for each system. Extra days beyond 1 week will be billed @ $1,200/day.

Price includes a one year warranty (See Appendix A for details) for labor and parts.

We trust this ClO_2 Generator System Proposal meets with your approval and we look forward to discussing this opportunity in greater detail at your convenience.

Respectfully Submitted,

David T. Schwartzel

David T. Schwartzel, P.Eng
Business Development Manager
DuPont Water Technologies

Office: (707) 474-9266
Cell: (916) 215-9837

Attachments:

1) IDI-DuPont One Year Limited Warranty
2) IDI-DuPont Standard Terms & Conditions
3)IDI-DuPont OXYCHLOR MGIII P&ID Drawings (Typical)

APPENDICES:

APPENDIX A: IDI-DUPONT ONE YEAR LIMITED WARRANTY

The One Year Limited Warranty applies to products manufactured and/or supplied by International Dioxcide, Inc. ("IDI") This limited warranty is given only to the first retail purchaser of such products and is not transferable to any subsequent owners or purchasers of such products.

IDI warrants that IDI or IDI authorized dealers will repair or replace, at IDI's option, any part of such products proven to be defective in materials or workmanship within one year from data of start-up (first day of commissioning) or eighteen months from date of the initial IDI invoice, whichever occurs first. Equipment must be maintained per Operation and Maintenance manual and IDI recommendations.

ANY REPAIR OR REPLACEMENT WILL BE WARRANTED ONLY FOR THE BALANCE OF THE ORIGINAL ONE (1) YEAR WARRANTY PERIOD.

USE OF NON-AUTHORIZED REPLACEMENT AND/OR MAINTENANCE PARTS WILL AUTOMATICALLY VOID THIS WARRANTY. ANY REPLACED PARTS MUST BE RETURNED TO IDI-DUPONT FOR WARRANTY EVALUATION.

This Warranty specifically excludes any components not manufactured by IDI that are external to the equipment supplied by IDI-DuPont, such as; related pumps, utilities, electrical or plumbing components, sensors, controllers, monitors, tanks, or, related components.

THIS LIMITED WARRANTY DOES NOT INCLUDE ANY OF THE FOLLOWING:

(a) Labor charges for troubleshooting, removal, or installation of such parts;
(b) Repair or replacement of such parts necessitated by faulty installation, or improper maintenance, improper operation, misuse, abuse, negligence, accident, fire, flood, repair materials, and/or unauthorized accessories;
(c) Claims originating from equipment installed without regard to required local codes and accepted trade practices;
(d) Freight charges for delivery of parts.

EXCEPT AS EXPRESSLY PROVIDED HEREIN, SELLER MAKES NO EXPRESS OR IMPLIED WARRANTY (INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR ARISING FROM ANY COURSE OF DEALING OR TRADE USAGE) REGARDING THE PRODUCT. IDI SHALL NOT BE LIABLE UNDER ANY CIRCUMSTANCES FOR LOSS OF USE OF SUCH PRODUCTS, LOST PROFITS, DIRECT DAMAGES, INDIRECT DAMAGES, CONSEQUENTIAL DAMAGES, FINES, JUDGEMENTS AND/OR INCIDENTAL DAMAGES.

This Warranty gives you specific legal rights. You may have other rights, which vary from State to State. Extended Warranties and Service Agreements are available. Contact IDI for details.

TO OBTAIN WARRANTY SERVICE:

Please Contact:

International Dioxcide, Inc.
Customer Service Number: (800) 295-3650
Fax Number: (401) 295-7108

PROVIDE:
1. Project, contact name, mailing address and telephone.
2. Installer/Mechanical Contractor.
3. Serial # and date of purchase.
4. The date of failure.
5. A description of the failure.

APPENDIX B: IDI-DUPONT STANDARD TERMS & CONDITIONS

STANDARD CONDITIONS OF SALE

1. Seller warrants only that (a) any products or services provided hereunder meet Seller's standard specifications for the same or such other specifications as may have been expressly agreed to herein; (b) the sale of any products or services provided hereunder will not infringe the claims of any validly issued United States patent covering such product or service itself, but does not warrant against infringement by reason of (i) the use of any information provided, (ii) the use of any product or service in combination with other products, services, or information or in the operation of any process, or (iii) the compliance by Seller with any specifications provided to Seller by Buyer; and (c) all products provided hereunder were produced` in compliance with the requirements of the Fair Labor standards Act of 1938, as amended.

WITH RESPECT TO ANY PRODUCTS, SERVICES, OR INFORMATION PROVIDED TO BUYER, SELLER MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Buyer assumes all risk and liability resulting from use of the products, services, or information delivered hereunder, whether used singly or in combination with other products, services, or information.

2. IN NO EVENT WILL SELLER'S AGGREGATE LIABILITY TO BUYER FOR ALL DAMAGES ARISING FROM ANY AND ALL CLAIMS RELATED TO THE BREACH OF THIS AGREEMENT, NONDELIVERY, OR THE PROVISION OF ANY PRODUCT, SERVICE, OR INFORMATION COVERED BY THIS AGREEMENT, REGARDLESS OF WHETHER THE FORM OF ACTION IS BASED ON CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY, STATUTE, OR OTHERWISE, EXCEED THE TOTAL PRICE PAID BY BUYER TO SELLER FOR THE PRODUCTS, SERVICES, OR INFORMATION IN RESPECT OF WHICH DAMAGES ARE CLAIMED. NO CLAIM SHALL BE ALLOWED FOR PRODUCT THAT HAS BEEN PROCESSED IN ANY MANNER. FAILURE TO GIVE NOTICE OF A CLAIM WITHIN NINETY (90) DAYS FROM DATE OF DELIVERY, OR THE DATE FIXED FOR DELIVERY (IN CASE OF NONDELIVERY) SHALL CONSTITUTE A WAIVER BY BUYER OF ALL CLAIMS IN RESPECT OF SUCH PRODUCTS, SERVICES, OR INFORMATION. PRODUCTS SHALL NOT BE RETURNED TO SELLER WITHOUT SELLER'S PRIOR WRITTEN PERMISSION. NO CHARGE OR EXPENSE INCIDENT TO ANY CLAIMS WILL BE ALLOWED UNLESS APPROVED BY AN AUTHORIZED REPRESENTATIVE OF SELLER. IN ADDITION, AND TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, EACH PARTY HERETO WAIVES ANY CLAIM TO INDIRECT, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR MULTIPLIED DAMAGES ARISING OUT OF OR RELATING TO THIS AGREEMENT OR THE PROVISION OF ANY PRODUCT, SERVICE, OR INFORMATION. TO THE EXTENT PERMITTED BY APPLICABLE LAW, THE PARTIES WAIVE AND AGREE NOT TO ASSERT NON-CONTRACTUAL CLAIMS ARISING UNDER STATE LAW RELATING TO THIS AGREEMENT OR THE PROVISION OF ANY PRODUCT, SERVICE, OR INFORMATION COVERED BY THIS AGREEMENT, AND THIS AGREEMENT SHALL BE DEEMED TO INCLUDE SUCH LANGUAGE AS MAY BE REQUIRED TO EFFECT SUCH WAIVER. WAIVER BY EITHER PARTY OF ANY DEFAULT BY THE OTHER HEREUNDER SHALL NOT BE DEEMED A WAIVER BY SUCH PARTY OF ANY DEFAULT BY THE OTHER WHICH MAY THEREAFTER OCCUR.

3. No liability shall result from delay in performance or nonperformance, directly or indirectly caused by circumstances beyond the control of the party affected, including, but not limited to, act of God, fire, explosion, flood, war, act of or

authorized by any Government, accident, labor trouble or shortage, pandemic, inability to obtain material, equipment or transportation, failure to obtain or hardship in obtaining reasonably priced supplies of materials, or failure of usual transportation mode. Quantities so affected may be eliminated from the agreement without liability, but the agreement shall remain otherwise unaffected. Seller shall have no obligation to purchase supplies of the product specified herein to enable it to perform this Agreement.

4. If for any reason including but not limited to Force Majeure Seller is unable to supply the total demand for products specified herein, Seller may distribute its available supply among any or all purchasers, as well as departments and divisions of Seller, on such basis as it may deem fair and practical, without liability for any failure of performance which may result therefrom.

5. Seller may furnish such technical assistance and information as it has available with respect to the use of the products or services covered by this agreement. Unless otherwise agreed in writing, all such information will be provided gratis. Buyer agrees to evaluate such information, to make an independent decision regarding the suitability of such information, products and services for Buyer's application, and only use such products, services and information pursuant to then current good product stewardship principles and all regulatory requirements applicable to Buyer's business.

6. Buyer acknowledges that it has received and is familiar with Seller's labeling and literature concerning the products and its properties. Buyer will forward such information to its employees, contractors and customers who may distribute, handle, process, sell or use such products, and advise such parties to familiarize themselves with such information. Buyer agrees that products sold hereunder will not knowingly be resold or given in sample form to persons using or proposing to use the products for purposes contrary to recommendations given by Seller or prohibited by law, but will be sold or given as samples only to persons who can handle, use and dispose of the products safely. Unless agreed to by Seller in a written agreement covering such use, in no event shall Buyer use products or resell products for use in the manufacture of any implanted medical device. Buyer agrees that export of any product, service or information provided hereunder shall be in accordance with applicable Export Administration Regulations.

7.Except as may be contained in a separate trademark license, the sale of product (even if accompanied by documents using a trademark or trade name of Seller) does not convey a license, express or implied, to use any trademark or trade name of Seller, and Buyer shall not use any trademark or trade name of Seller in the conduct of its business without Seller's prior written consent.

8. The Buyer shall reimburse the Seller for all taxes, (excluding income taxes) excises or other charges which the Seller may be required to pay to any Government (National, State or Local) upon the sale, production or transportation of the products, services, or information sold hereunder.

9. In the event Buyer fails to fulfill Seller's terms of payment, or in case Seller shall have any doubt any time as to Buyer's financial responsibility, Seller may decline to make further deliveries except upon receipt of cash or satisfactory security.

10. This agreement is not assignable or transferable by Buyer, in whole or in part, except with the prior written consent of Seller. Seller reserves the right to sell, assign, or otherwise transfer its right to receive payment under this agreement.

11. Dispute Resolution and Arbitration - Buyer and Seller agree to arbitrate all disputes, claims or controversies whether based on contract, tort, statute, or any other legal or equitable theory, arising out of or relating to (a) this Agreement or the relationship which results from this Agreement, (b) the breach, termination or validity of this Agreement, (c) the purchase or supply of any product, service, or information provided by Seller, (d) events leading up to the formation of Buyer's and Seller's relationship, and (e) any issue related to the creation of this Agreement or its scope, including the scope and validity of this paragraph. The parties shall before and as a condition to proceeding to arbitration attempt in good faith to resolve any such claim or controversy by mediation under the International Institute for Conflict Prevention & Resolution ("CPR") Mediation Procedure then currently in effect. Unless the parties agree otherwise, the mediator will be selected from the CPR Panels of Distinguished Neutrals. Any such claim or controversy which remains unresolved 60 days after the appointment of a mediator or 60 days after good faith efforts by either party to proceed to mediation shall be finally resolved by binding arbitration in accordance with the CPR Rules for Non-Administered Arbitration then currently in effect by three independent and impartial arbitrators, none of whom shall be appointed by either party. This Agreement shall be governed by the Federal Arbitration Act, 9 U.S.C. §§ 1-16, to the exclusion of any state laws inconsistent therewith. Such arbitration shall be conducted in a city to be chosen by the arbitrators which is not the principal place of business of either party, and the arbitrators and the parties shall conduct such arbitration in accordance with such procedures as may be necessary to permit use of the then current CPR

Arbitration Appeal Procedure. Any judgment upon the award rendered by the arbitrator(s) may be entered by any court having jurisdiction thereof. In the event that either party wishes to appeal an award, the parties shall follow the then current CPR Arbitration Appeal Procedure. Buyer and Seller agree not to file or join any class action or class arbitration, seek or consent to class relief, or seek or consent to the consolidation or joinder of its claims with those of any third party. If any clause within this Arbitration Provision (other than the agreement regarding the conduct of the arbitration in the preceding sentence) is found to be illegal or unenforceable, that clause will be severed from this Arbitration Provision, and the remainder of the Arbitration Provision will be given full force and effect. If such agreement regarding the conduct of the arbitration is found to be illegal or unenforceable and if the arbitrators permit a class arbitration or consolidated or joined matter to proceed, this entire Arbitration Provision will be unenforceable, and the dispute may be decided by a court. The obligations set forth in this paragraph shall survive the termination or expiration of this Agreement.

12. This Agreement shall be construed and governed by Delaware law, without regard to any applicable conflicts of law provisions, and the terms of the UCC, rather than the United Nations Convention on Contracts for the International Sale of Goods, shall apply.

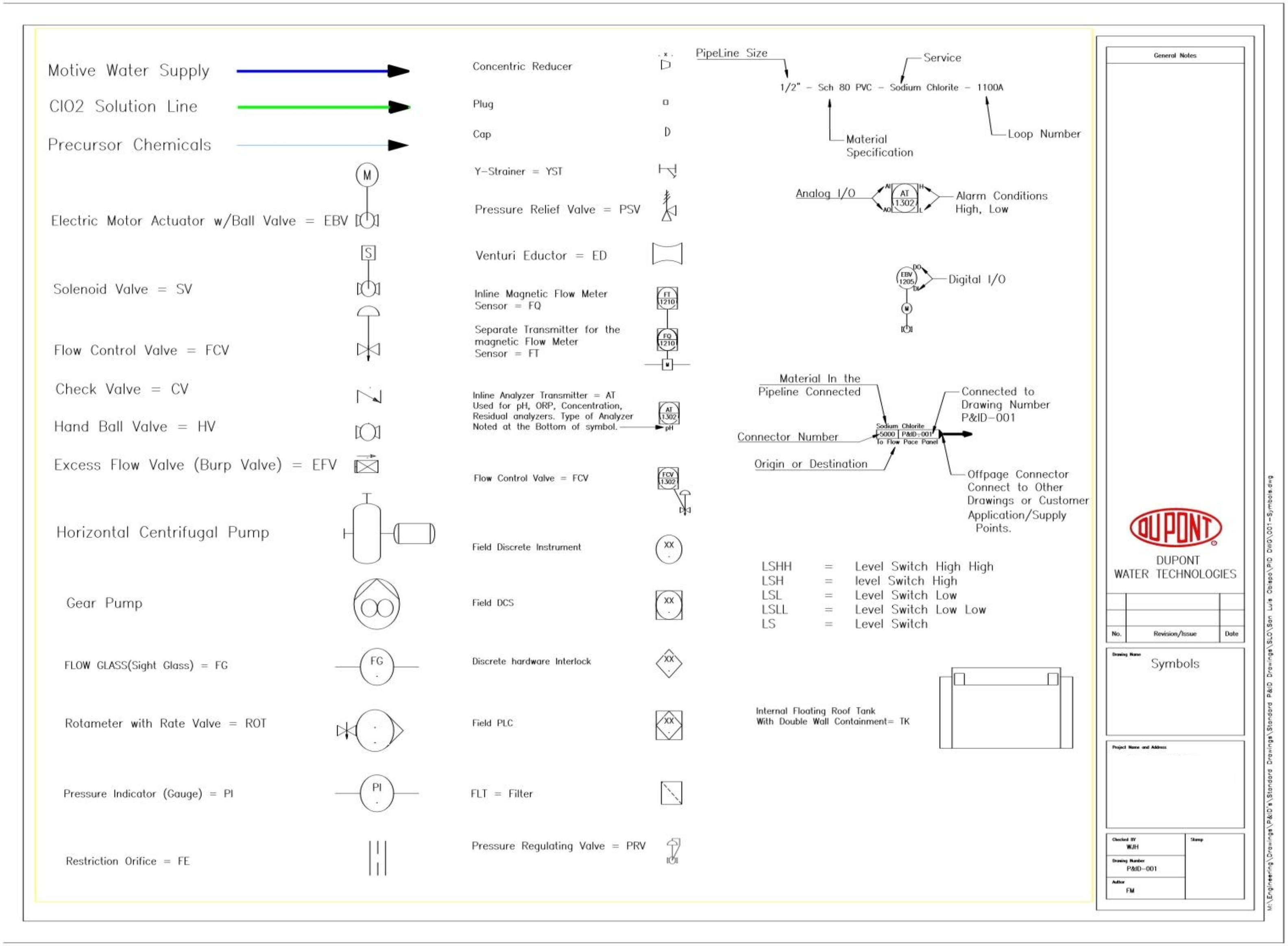
13. Except as otherwise expressly provided in any other term or condition of this Agreement, title, liability for and risk of loss to Product sold hereunder passes to Buyer upon loading for shipment at Seller’s producing location.

14. Except as expressly provided in any other term or condition of this Agreement, any provision hereof which is prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective only to the extent of such prohibition or unenforceability without invalidating the remaining provisions hereof or affecting the validity or enforceability of such provision in any other jurisdiction.

15. This Agreement supersedes all prior agreements, representations and understandings between the parties (whether written or oral) with respect to its subject matter and constitutes (along with the exhibits and schedules attached hereto) a complete and exclusive statement of the terms of the agreement between the parties with respect to the provision of products or services hereunder. Not by way of limitation of the unqualified nature of the foregoing, Buyer acknowledges, agrees and represents that it is not relying upon, and it has not been induced by, any representation, warranty, statement made by, or other information provided by Seller in connection with its decision to purchase or use any product, service, information or technology, other than the representations and warranties made by Seller as and only to the extent expressly provided in this Agreement. No modification of this Agreement shall be binding upon Seller unless separately contracted in writing and executed by a duly authorized representative of Seller. No modification shall be effected by the acknowledgment or acceptance of purchase order forms stipulating different conditions.

Ver. 5/11/07

APPENDIX C: P&ID DRAWINGS



Motive Water Supply
ClO2 Solution Line
Precursor Chemicals
M
Electric Motor Actuator w/Ball Valve = EBV
S
Solenoid Valve = SV
Flow Control Valve = FCV
Check Valve = CV
Hand Ball Valve = HV
Excess Flow Valve (Burp Valve) = EFV
Horizontal Centrifugal Pump
Gear Pump
FLOW GLASS(Sight Glass) = FG
FG
Rotameter with Rate Valve = ROT
Pressure Indicator (Gauge) = PI
PI
Restriction Orifice = FE
Concentric Reducer
Plug
Cap
Y-Strainer = YST
Pressure Relief Valve = PSV
Venturi Eductor = ED
Inline Magnetic Flow Meter Sensor = FQ
FT 1210
Separate Transmitter for the magnetic Flow Meter Sensor = FT
FQ 1210
Inline Analyzer Transmitter = AT Used for pH, ORP, Concentration, Residual analyzers. Type of Analyzer Noted at the Bottom of symbol.
AT 1302
pH
Flow Control Valve = FCV
FCV 1302
Field Discrete Instrument
XX
Field DCS
XX
Discrete hardware Interlock
XX
Field PLC
XX
FLT = Filter
Pressure Regulating Valve = PRV
PipeLine Size
Service
1/2" - Sch 80 PVC - Sodium Chlorite - 1100A
Material Specification
Loop Number
Analog I/O
AI
AO
AT 1302
H
L
Alarm Conditions High, Low
EBV 1205
DO
DI
M
Digital I/O
Material In the Pipeline Connected
Connected to Drawing Number P&ID-001
Sodium Chlorite
5000
P&ID-001
To Flow Pace Panel
Connector Number
Origin or Destination
Offpage Connector Connect to Other Drawings or Customer Application/Supply Points.
LSHH = Level Switch High High
LSH = level Switch High
LSL = Level Switch Low
LSLL = Level Switch Low Low
LS = Level Switch
Internal Floating Roof Tank With Double Wall Containment= TK
General Notes
DUPONT
WATER TECHNOLOGIES
No.
Revision/Issue
Date
Drawing Name
Symbols
Project Name and Address
Checked BY
WJH
Stamp
Drawing Number
P&ID-001
Author
FM
M:\Engineering\Drawings\P&ID's\Standard Drawings\Standard P&ID Drawings\SLO\San Luis Obispo\PID DWG\001-Symbols.dwg

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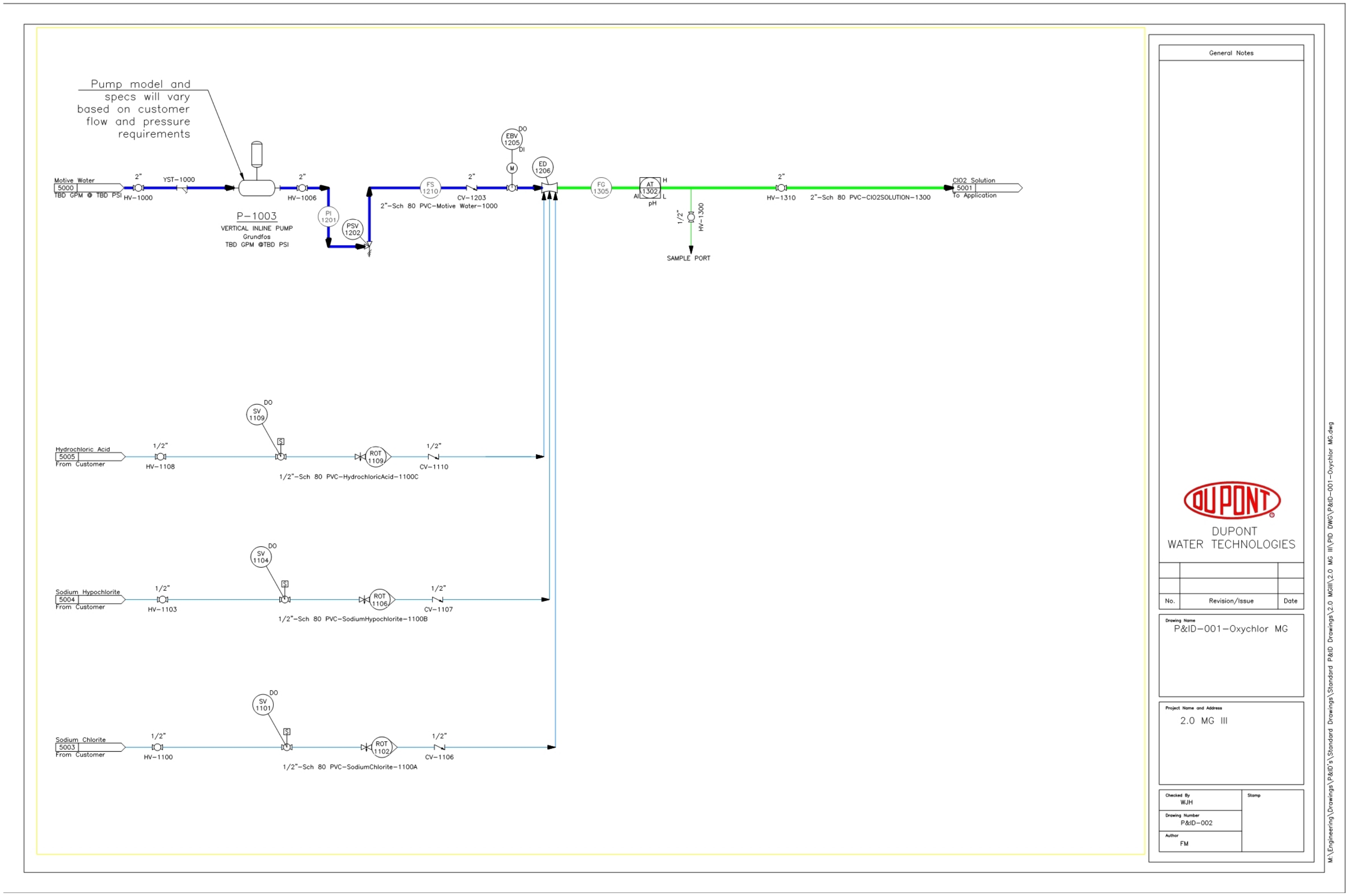

Drawing Name: P&ID-001-Oxychlor MG

Project Name and Address: 2.0 MG III

Checked By: WJH

Drawing Number: P&ID-002

Author: FM

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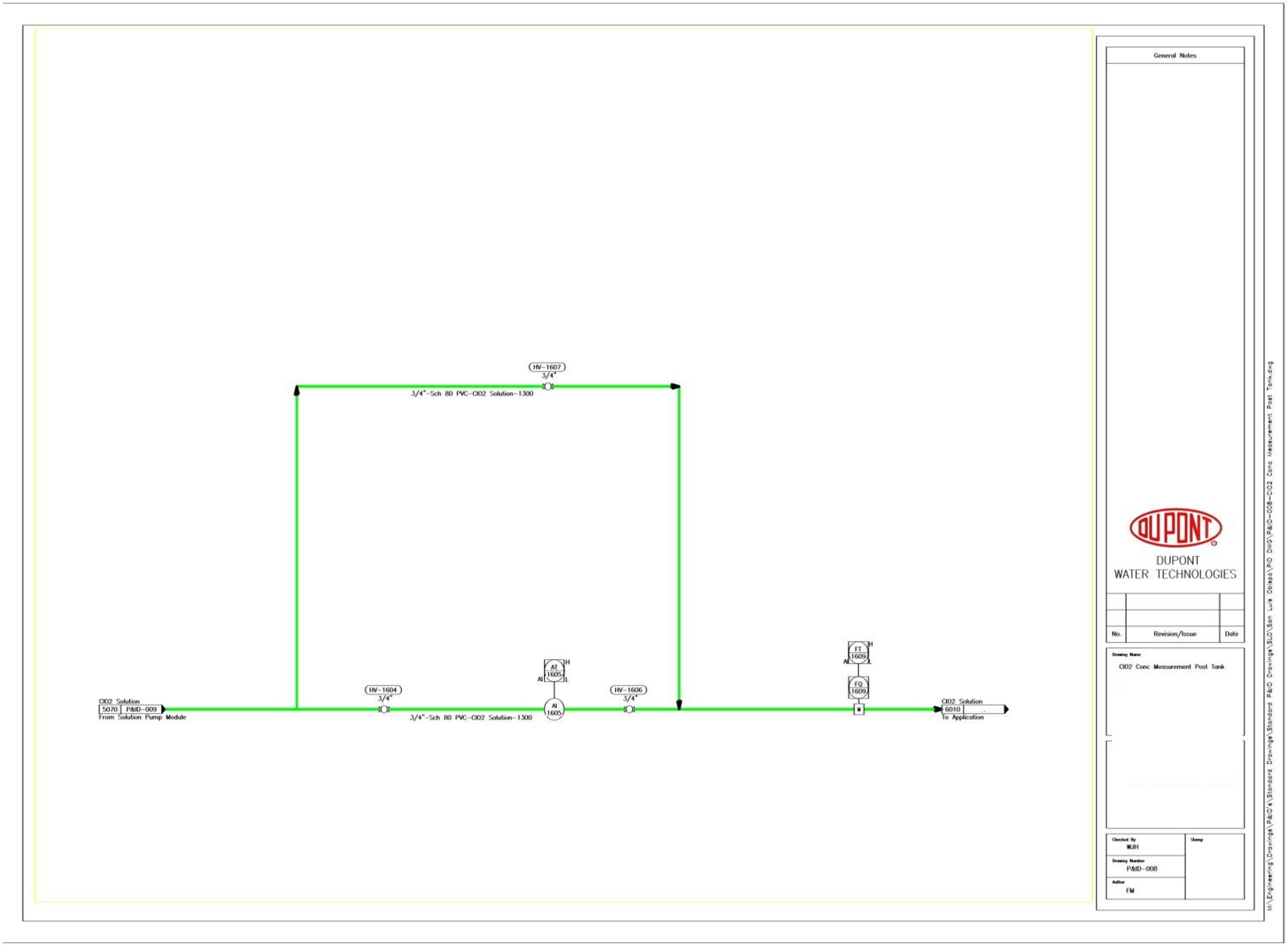
HV-1607
3/4"
3/4"-Sch 80 PVC-ClO2 Solution-1300
ClO2 Solution
5070
P&ID-009
From Solution Pump Module
HV-1604
3/4"
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HV-1606
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ClO2 Solution
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DUPONT
WATER TECHNOLOGIES
No.
Revision/Issue
Date
Drawing Name
ClO2 Conc Measurement Post Tank
Checked By
WJH
Drawing Number
P&ID-008
Author
FM
Stamp
M:\Engineering\Drawings\P&ID's\Standard Drawings\Standard P&ID Drawings\SLO\San Luis Obispo\PID DWG\P&ID-008-ClO2 Conc Measurement Post Tank.dwg

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APPENDIX B
Hydac RF3 Automatic Self-Cleaning Filters

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HYDAC INTERNATIONAL

AutoFilt® RF3 Automatic Self-Cleaning Filter

www.hydacusa.com

DESIGN

The AutoFilt® RF3 is an automatic self-cleaning filtration system designed for continuous maintenance-free filtration for all major manufacturing and processing industries. It removes solid contamination from low viscosity fluids such as water and machine tool coolants. Its rugged construction and self-cleaning feature provide companies with increased machinery reliability resulting in reduced operating, labor and maintenance costs.

Superior removal of contamination particles from water is accomplished with Slotted Tube / Wedge Wire Filter Elements ranging from 50 to 3,000 microns and SuperMesh™ Filter Elements with 25 and 40 microns.

The automatic self-cleaning process begins, as soon as, the filter elements become contaminated. Due to the unique single element cleaning process, the total filtered flow is not reduced during the cleaning process.

Flow rates range can range from 20-31,000 GPM and housings are available with ANSI mounting port flanges from 2” to 36”.

HYDAC can supply numerous combinations of housing materials, as well as, system operating equipment to reach the optimum installation for every industry application.

COST EFFECTIVENESS

Particle contamination in water accelerates the rate of wear on system components such as spray nozzles, water valves, and pipelines. This could result in premature component failure.

The use of automatic self-cleaning filters lead to a significant decrease in service and maintenance intervals resulting in time and labor savings. As well, costs for replacement equipment and waste disposal can be minimized.

Process water is typically contaminated with solids and water companies apply surcharges to handle the contaminant discharge. The HYDAC AutoFilt® RF3 is ideally suited for removing these contaminants prior to discharge thus reducing or eliminating any financial surcharge.

TECHNICAL DATA

Flow Rates
- 20 - 31,000 gpm

ANSI Flange Sizes
- 2” - 36”

Filtration Micron Ratings
- 25 - 3000 µm

Maximum Operating Pressure
- 90 to 150 psi*

Power Source
- Electric, Pneumatic, or Electro-pneumatic

Power Requirements
- 480 3-phase VAC*
- 80 psi air pressure

Filter Housing Material
- Carbon Steel
- Stainless Steel 316Ti

Internal Parts
- Stainless Steel 304

Self-Cleaning Valve
- Stainless Steel akin 316

Filter Elements
- Stainless Steel 316L

Corrosion Protection for Carbon Steel Vessel
- Polyurethane
- Rubber coating

Special Coatings and Steels are Available for Severe Fluid Applications

Filter Vessel Certification
- ASME Code available

*Other Models Available, Consult Factory

Model Code: Filter Assembly

RF3 5 EPT NG N 1 3 0 / KS1000 5 12345678

Filter Type
RF3 = AutoFilt®

Filter Size

		Flow Range (GPM)	ANSI Flange
C	=	20 - 120	2”
0	=	110 - 500	4”
1	=	400 - 1120	6”
2	=	880 - 1980	8”
2.5	=	1760 - 2600	10”
3	=	2420 - 3780	12”
4	=	3550 - 7480	16”
5	=	6600 - 10,780	20”
6	=	8800 - 15,850	24”
7	=	13,200 - 22,000	28”
8	=	19,800 - 31,000	36”

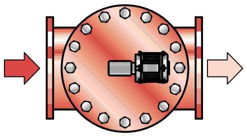
Drive Control / Connecting Voltage
EPT = Electric / Pneumatic cycle control, Δp dependent
EU = Electric control, Δp dependent
PT = Pneumatic cycle control, Δp dependent, size C-4
PTZ = Pneumatic cycle timed control, size C-4
7 = 3X415V/N/PE 60Hz
8 = 3X460V/X/PE 60Hz

Housing Material / Corrosion Protection
N = Standard steel 1.0038, outside primed
NM = Standard steel 1.0038, outside primed, inside metallogal® painted *(Polyurethane)*
NG = Standard steel 1.0038, outside primed, inside rubber coated *(Butyl Coated)*
E = Stainless steel 1.4571
A = with ANSI-flanged, additional A at the end

Shut-Off Valve Material
N = Standard steel
E = Stainless steel

Differential Pressure Gauge
1 = Pressure chamber, Aluminum 3.258302
2 = Pressure chamber, Stainless steel 1.4305
3 = with pressure mediators stainless steel 315 TI

Flange Position Inlet & Outlet
1 = outlet opposite inlet *(standard)*
2 = outlet turned 90° clockwise direction compared to standard
3 = outlet turned 180° clockwise direction compared to standard
4 = outlet turned 270° clockwise direction compared to standard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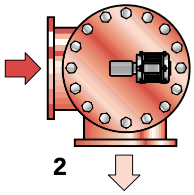
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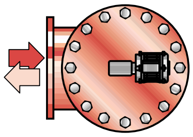
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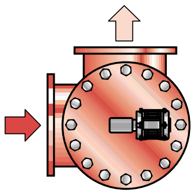

4

Modification Number

Element Set
KD25 = Conical SuperMesh™
KD40 = Conical SuperMesh™
KS50 = Conical slotted tubes *(wire wedge)*
KS100 = Conical slotted tubes *(wire wedge)*
KS200 = Conical slotted tubes *(wire wedge)*
KS300 = Conical slotted tubes *(wire wedge)*
KS400 = Conical slotted tubes *(wire wedge)*
KS500 = Conical slotted tubes *(wire wedge)*
KS1000 = Conical slotted tubes *(wire wedge)*
KS1500 = Conical slotted tubes *(wire wedge)*
KS2000 = Conical slotted tubes *(wire wedge)*
KS2500 = Conical slotted tubes *(wire wedge)*
KS3000 = Conical slotted tubes *(wire wedge)*

Size of Element Set
Use same code selected in **filter size**

Drawing Number
(omit) = standard version
For special versions a number will be provided after technical clarification at head office

Vessel Certification
(omit) = standard version
ASME = ASME version

OPERATION

The design of the AutoFilt® RF3 Self-Cleaning Filter is simple yet highly effective. The basic construction consists of the main housing, inlet and outlet ports with flanged connections, filter elements, outlet valve and actuator and electronic operating controls. All of these combined together provide a completely automated self-cleaning filtration system.

The process begins with fluid passing through the inlet flange reaching the filter elements by flowing from inside the element to outside. Solid contamination is then trapped on the inside of the Wedge-Wire filter element. As contamination increases, the differential pressure between the contaminated and clean side increases. When the set differential pressure is reached, 7 psid typical, self-cleaning process is triggered.

Note: This self-cleaning activation has an adjustable differential pressure or time setting. (see *Starting the Automatic Self-Cleaning Process* on page 6.)

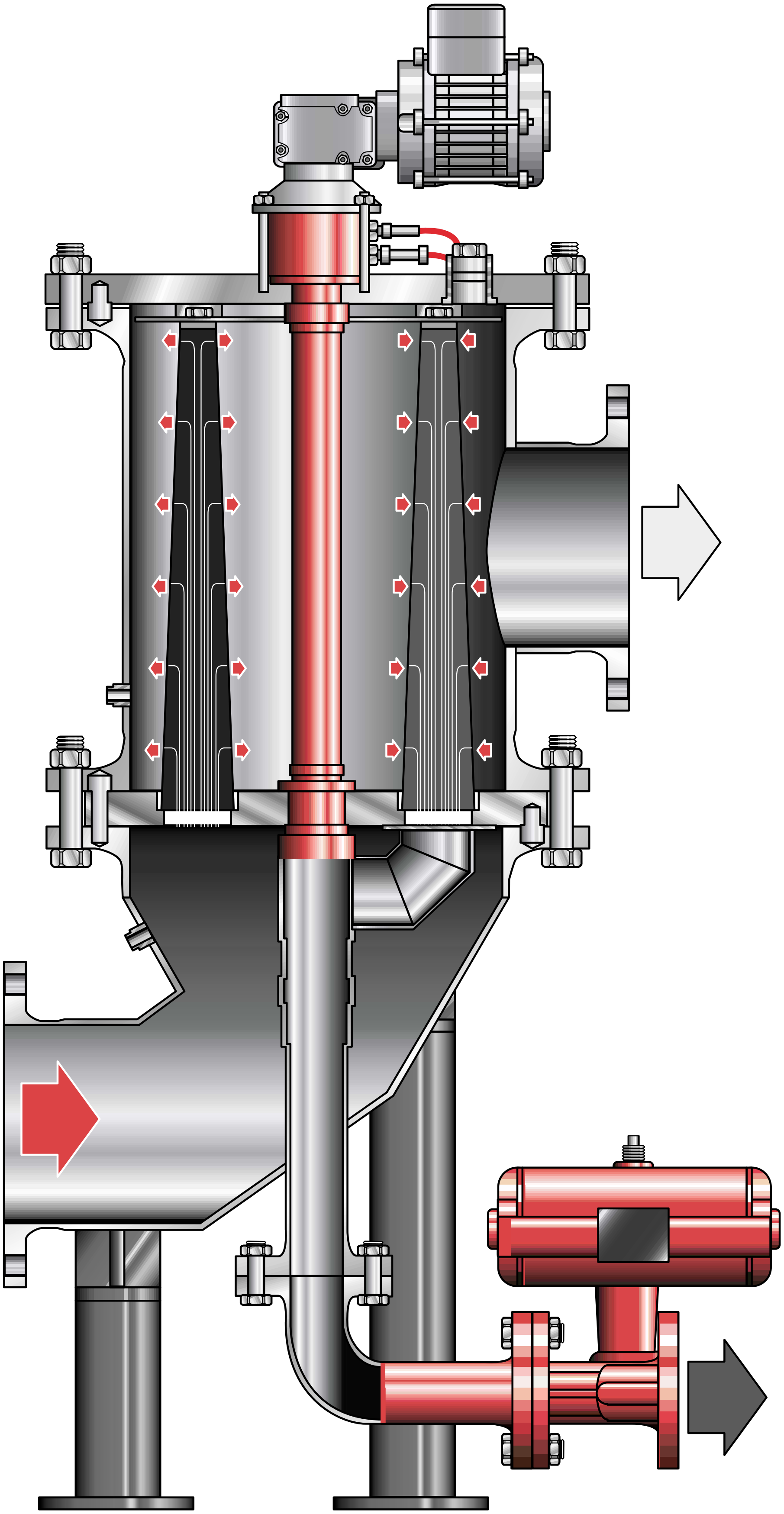
The self-cleaning process is one complete cycle which cleans one element at a time in succession. The geared motor turns the contamination discharge arm under the filter element to be cleaned. The contamination discharge valve is then opened by an actuator. This results in a high pressure drop within the filter element being cleaned, which forces the particles into the discharge line. During this operation, only a small amount of clean fluid is used to complete the cleaning process.

A typical self-cleaning cycle takes less than 30 seconds. The cleaning cycle takes place with no interruption in flow or pressure drop.

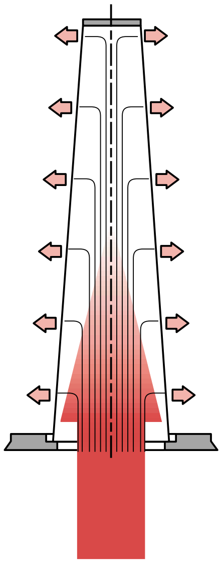
The unique conical element design and internal mounting configuration allows for smooth flow transition, resulting in a minimal pressure loss during the cleaning process.

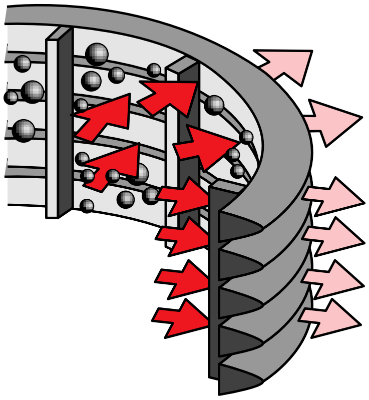
Advantage to the customer: Fewer self-cleaning cycles and a minimum loss of flushing fluid.

Cutaway: RF3

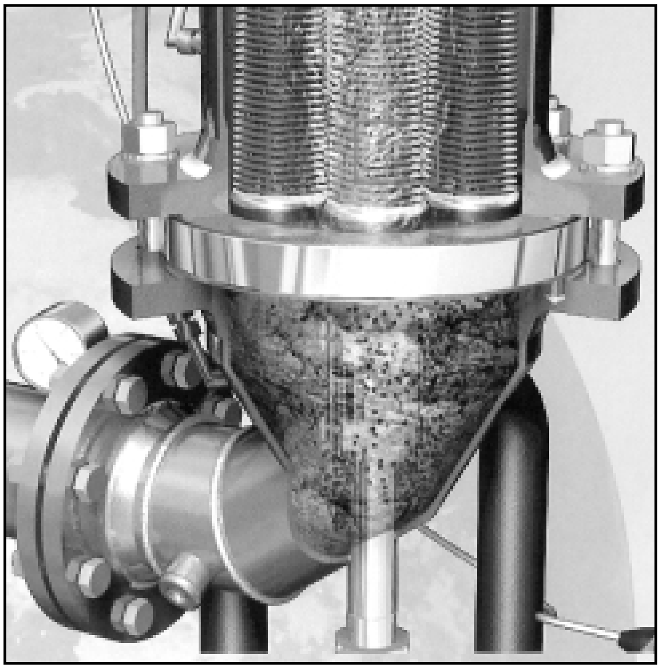


Element Filtering:
Inside to Outside

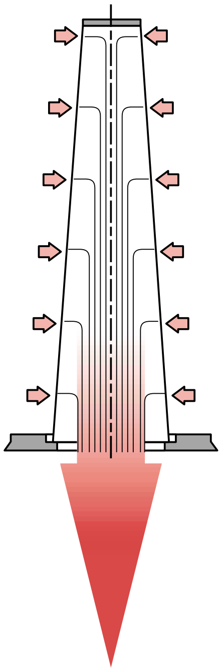


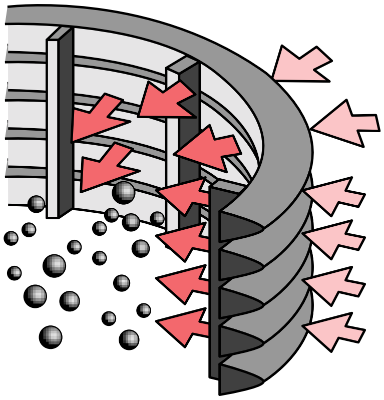


Vessel Filtration:
Inside to Outside

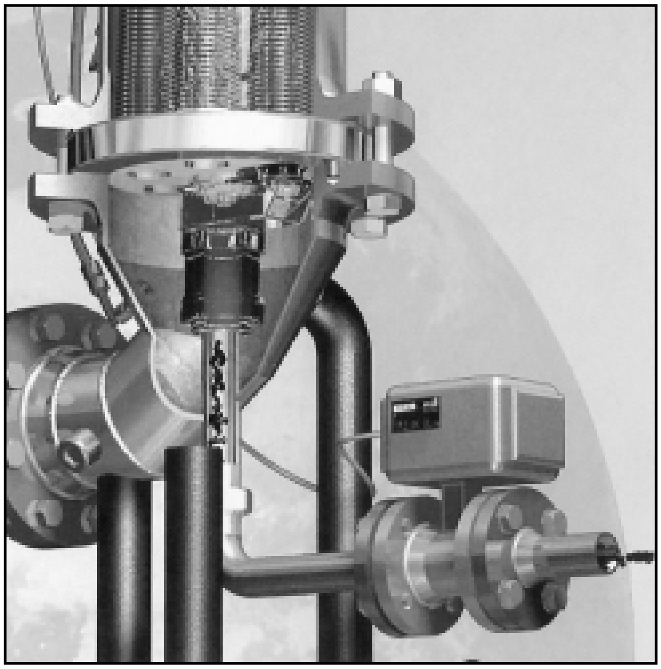


Element Back-Flushing:
Outside to Inside



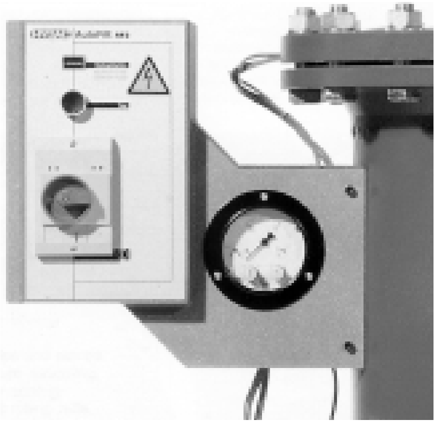


Vessel Self-Cleaning:
Outside to Inside



Starting The Automatic Self-Cleaning Process

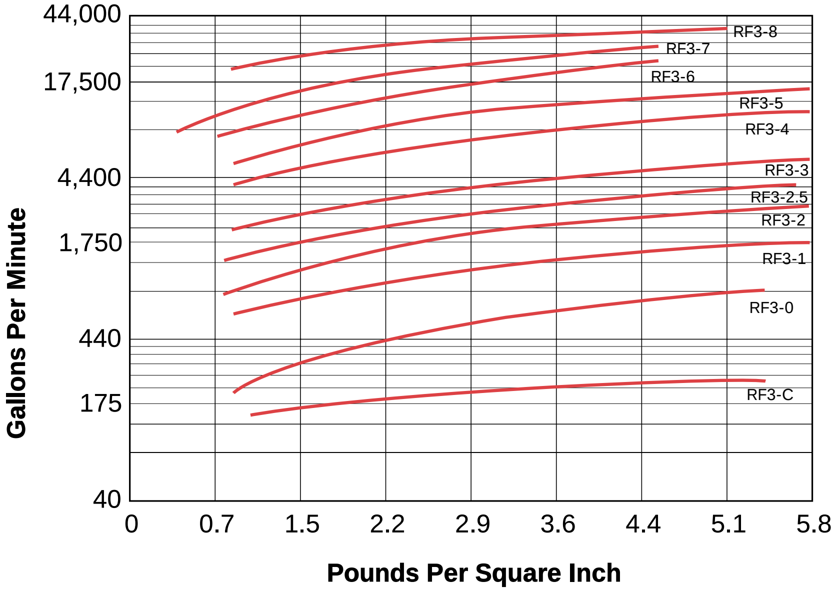
- Pressing the Test Button on the Control Panel
- Electrically activated Test Button
- Differential Pressure set point is exceeded, e.g., 7 psid
- Adjustable Timer, e.g., 12 hours
- Combination Differential Pressure and Adjustable Timer



Ready To Operate

The filter control unit and differential pressure measuring lines are already connected. Once the inlet, outlet, and discharge lines have been attached, only the power and/or air supply need to be connected.

Flow Curves



Note: The curves are for filter rating from 100 µm - 3000 µm. For 50 µm the pressure drop increases by 30%. This is true for sizes RF3 0 - 8. For RF3 C there is no increase in pressure drop. For 25, 40, and 50 µm the pressure drop increases by 30%.

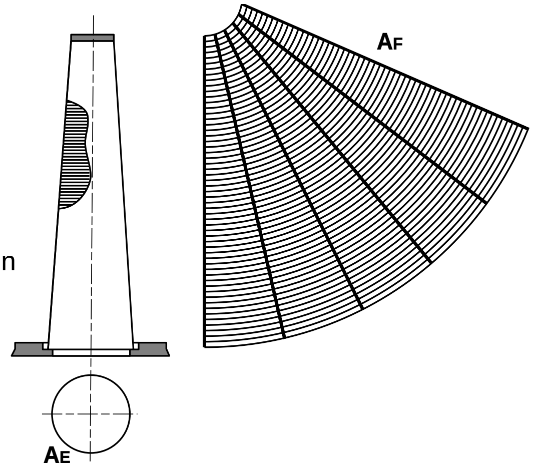
Element Opening Quotient

EFQx determines consistent flow without reverse flow through the filter element during the filtering and self-cleaning process. The EFQx value is the ratio of the opening filtration surface of an element to the cross section of the opening of the element inlet.

$$EFQ_x = \frac{A_F}{A_E}$$

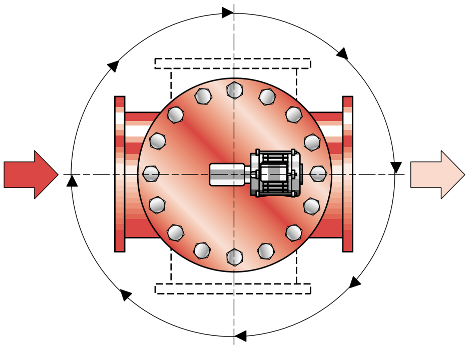
X = Filtration rating in µm

Example: $EFQ_{100} < 3$ for elements with filtration rating of 100 µm



Variable Filter Geometry

The outlet flange can be oriented in any 90˚ increment in comparison to the inlet. The discharge line incorporates a slip flange which enables positioning at any angle in which the housing legs do not interfere. The AutoFilt RF3 can be easily integrated into any plant due to these flexible mounting options.



Filter Elements

Types and Micron Ratings

- Slotted tube *(Wedge-Wire)* 50 - 3000 µm
- SuperMesh™ 25 and 40 µm

Advantages of the AutoFilt® RF3	...and the Benefits to You!
Extensive standard features for numerous applications	Excellent price to performance ratio
Automatic operation	Reliable and safe Set it & Forget it Low operating costs
Continuous fluid flow during self-cleaning	No interruption of unit operation Minimum fluid loss
Flow rate up to 31,000 gpm	High process performance
Service friendly	Low maintenance & replacement part costs
Isokinetic filtration and cleaning	Maximum utilization of filter surface area Full filtration performance after cleaning process
Conical filter elements	Minimal Dp curve Optimum EFQx
Slotted-tube filter elements	Long service life Optimum filtration and cleaning properties
Pulse-aided cleaning	Additional dynamic element cleaning with low loss of cleaning fluid
Adjustable controls	Customer-specific for numerous applications
Flow-optimized filtration	High flow characteristics in compact dimensions
Static sealing between contaminated and clean sides	Guaranteed high filtration quality
Variable housing isometry	Reduced costs due to space saving and simple installation
Numerous equipment options	Customer specific for numerous applications
Ready to operate unit	Simple installation and commissioning
ISO 9001 certification	High quality & performance standards

APPLICATIONS

WATER PLANTS:
AutoFilt® RF3 installed as a 1st stage filter for the removal of sand and debris from underground water. Extended life is provided to the cartridge elements protecting reverse osmosis systems.

PROCESS WATER:
AutoFilt® RF3 is used to remove solid contamination from incoming river and lake process water. Protection is provided to critical plant operating components. As well, the AutoFilt® RF3 can be used to filter discharge water, thus reducing and/or eliminating excessive water company surcharges.

POWER PLANTS:
AutoFilt® RF3 is used to remove scale from water protecting cooling generators. Filtration of the power plant sealing water will increase the service life of turbine shaft sliding-ring seals.

COOLING TOWERS:
AutoFilt® RF3 is used to filter water used in cooling towers to prevent the clogging of the condensers.

STEEL INDUSTRY:
AutoFilt® RF3 is used to protect nozzles and pumps during the high pressure descaling process. In addition, protection is provided during the cooling process for blast furnaces and rolling mills.

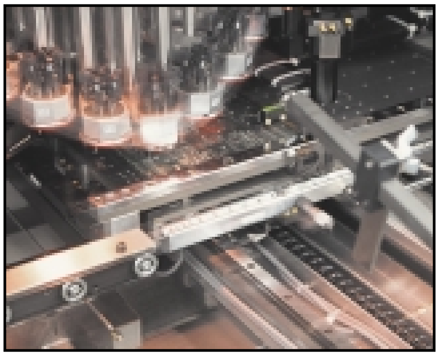
PAPER INDUSTRY:
AutoFilt® RF3 is used to protect nozzles from becoming clogged on paper machines.

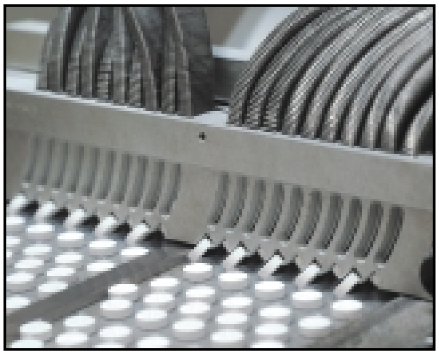
MACHINE TOOLS:
AutoFilt® RF3 is used to filter cooling lubricants used on machine tools.

STEAM SUPPLY:
AutoFilt® RF3 is used to remove piping scale protecting the heat exchangers.

FOOD INDUSTRY:
AutoFilt® RF3 is used to filter supplied municipal water used in food processing.

CHEMICAL PLANTS:
AutoFilt® RF3 is used to filter process water used by chemical plants for cooling and production.





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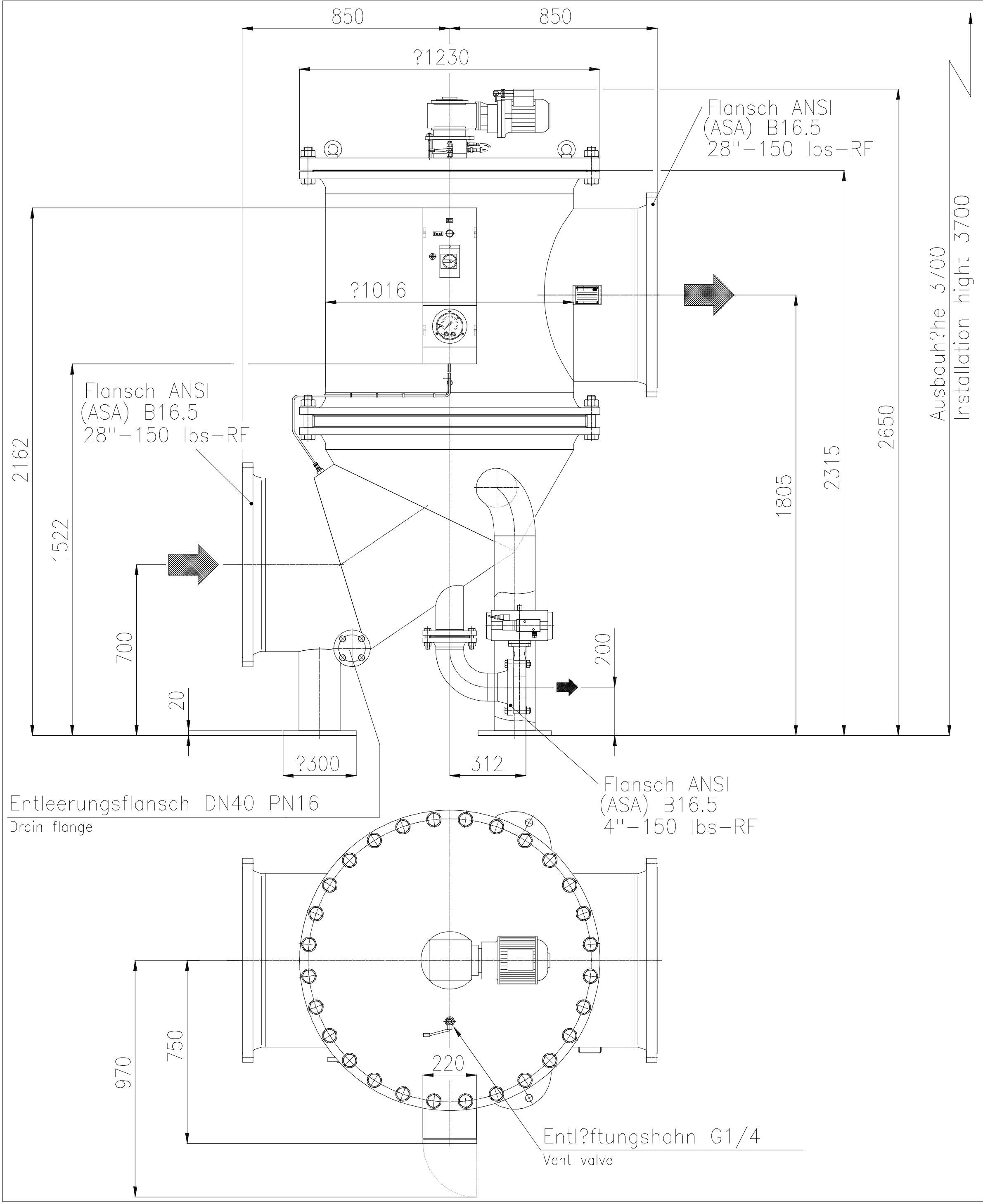
Schutzvermerk nach DIN 34 beachten !



Techn. Daten
Technical data

Zul. Betriebs?berdruck : 6 bar
Allowable operating pressure

Zul. Betriebstemperatur : 90 ?C
Allowable operating temperature

Anzahl Filterelemente : 44
Number of filterelements

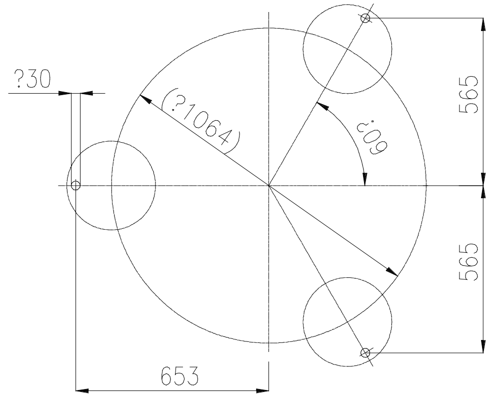
Filterfeinheit : 50–3000 ?m
Filtration rating

Filterelement : Spaltrohr
Filterelement slotted tube

Gewicht : 1950 kg (leer)
Weight (empty)

Inhalt : Ca. 1355 l
Volume

Befestigungsl?cher
Fixing points



Die in der Zeichnung angegebenen Ma?e
The dimensions indicated in the drawing
sind mit ?5 mm toleriert.
tolerated with ?5 mm.

Allgemeintoleranzen
ISO 2768

L?ngenma?e

?ber bis	0,5 6	6 30	30 120	120 400	400 1000
	?0,1	?0,2	?0,3	?0,5	?0,8

Werkst?ckkanten DIN 6784 – . + .

Rundungshalbmesser Fasen, Winkel

Form und Lage Genauigkeitsgrad angeben! Wenn nicht gilt "H"

Genauigkeitsgrad "m" H ○ K ○ L ○

Pa?ma?e Abma?e

Anz. Index	gepr.am ge?nd.am	gepr.von ge?nd.von	?.M.Nr.
. .	. .	. .	.
2 c	28.03.02 27.03.02	HAUSDORF KUHN I.	642997
1 b	04.05.01 03.05.01	HAUSDORF KUHN I.	625873
1 a	25.01.00 20.01.00	HAUSDORF KUHN I.	618981

2000	Tag	Name
Gez.	13.01.	MOLITOR M.
Gepr.	13.01.	HAUSDORF
Norm.	.	.

Werkstoff ..
Teile-Nr. .
Fertigma?e ..

Rauheitsklasse DIN ISO 1302

?m	N2	N3	N4	N5	N6	N7	N8	N9	N10
Rz	0,25	0,5	1	2	4	8	16	32	63
Ra	0,05	0,1	0,2	0,4	0,8	1,6	3,2	6,3	12,5

Ma?stab 1:12
Modell-Nr. .
Zeichnung besteht aus 1 Blatt
Blatt: 1
Masse 0.000 kg

HYDAC FILTERTECHNIK

Auftrag-Nr.

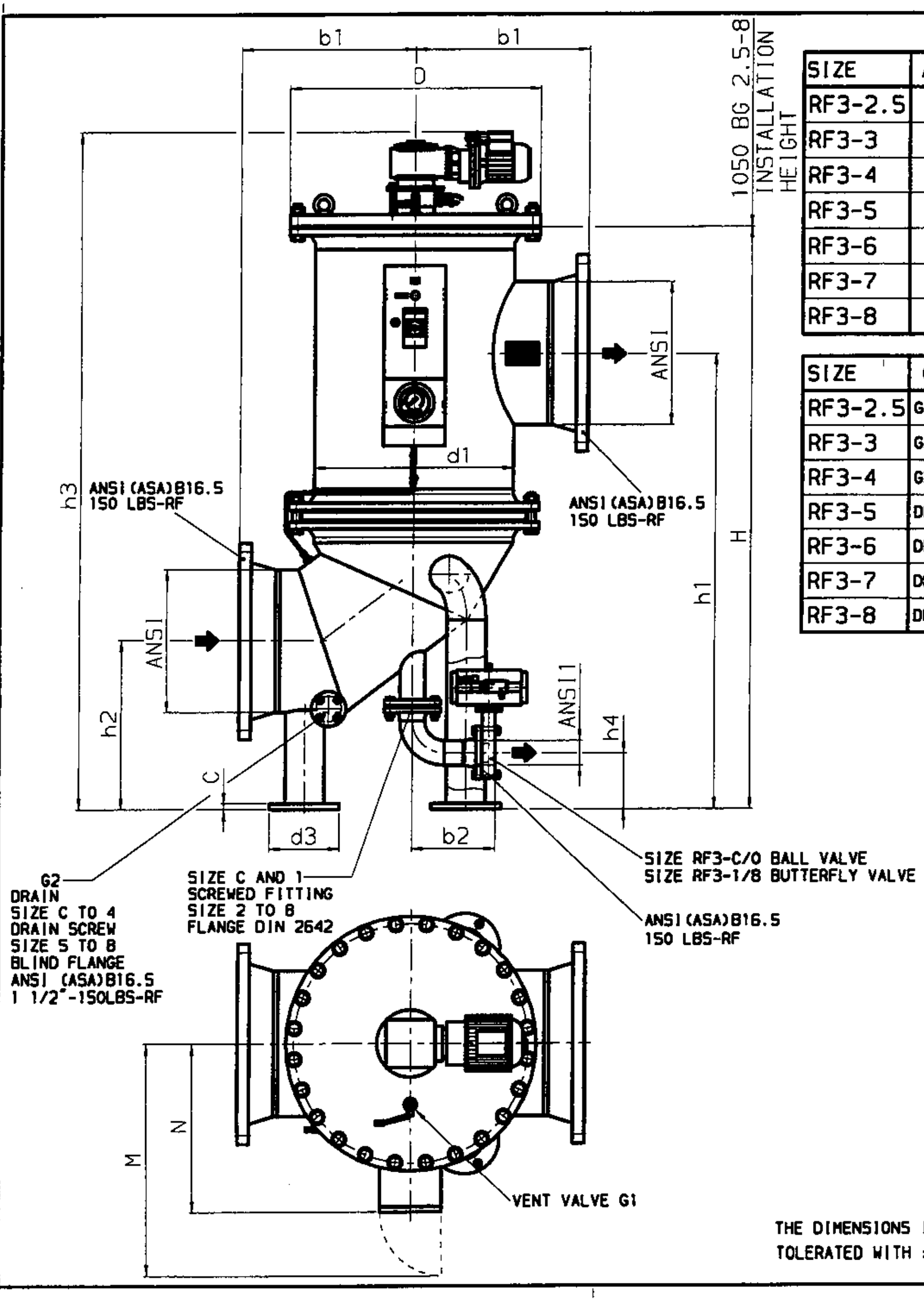
Benennung
Rueckspuelfilter
RF3–7–EPT/ANSI

Teile-Code-Nr.
07 710 972 2 03034444
Ers. f?r: .
Ers. durch: .

Computererstellte Zeichnung (CAD)

KAZSCALE

Schutzvermerk nach DIN 34 beachten !



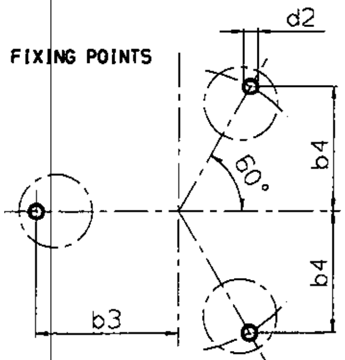
SIZE	ANSI	ANSI1	b1	b2	C	H	h1	h2	M	N	G1
RF3-2.5	10"	2"	325	312	12	1760	1300	400	440	660	G1/4
RF3-3	12"	2 1/2"	380	276	12	1888	1380	500	485	705	G1/4
RF3-4	16"	3"	500	296	20	2033	1525	600	540	760	G1/4
RF3-5	20"	3"	550	296	20	2080	1635	600	593	813	G1/4
RF3-6	24"	4"	625	312	20	2280	1745	675	698	918	G1/4
RF3-7	28"	4"	750	312	20	2315	1805	700	750	970	G1/4
RF3-8	36"	6"	950	560	20	3183	2543	1000	850	1070	G1/4

SIZE	G2	h3	h4	D	d1	d2	d3	b3	b4	WEIGHT FILTER EMPTY KG	WEIGHT FILTER IN SERVICE KG*	FILTER-ELEMENTE
RF3-2.5	G3/4	2075	120	565	406	18	160	270	235	450	640	6
RF3-3	G3/4	2185	155	670	508	18	160	322	278	570	850	9
RF3-4	G3/4	2330	220	780	610	22	200	375	357	750	1175	18
RF3-5	DN40	2415	200	895	711	27	250	485	420	1020	1655	24
RF3-6	DN40	2615	200	1115	914	30	300	596	515	1610	2608	40
RF3-7	DN40	2650	200	1230	1016	30	300	653	565	1950	3305	44
RF3-8	DN40	3506	229	1405	1220	30	300	716	620	3550	6260	54

SUBJECT TO TECHNICAL MODIFICATIONS

*WITH WATER

FIXING POINTS



THE DIMENSIONS INDICATED IN THE DRAWING TOLERATED WITH ±5 MM.

Allgemeintoleranzen ISO 2768

Längenmaße

über bis	0,5 6 ±0,1	6 30 ±0,2	30 120 ±0,3	120 400 ±0,5	400 1000 ±0,8

Werkstückkanten DIN 6784

Rundungshalbmesser Fasen, Winkel

Form und Lage Genauigkeitsgrad angeben! Wenn nicht gilt "H"

Genauigkeitsgrad "a" H ○ K ○ L ○

Paßmaße | Abmaße

1 / i	04.02.03 / 04.02.03	SCHNEID. T. / KUHN I.	653152
2 / h	28.03.02 / 27.03.02	HAUSDORF / KUHN I.	642997
1 / g	08.03.02 / 08.03.02	LANG N. / KUHN I.	642615
1 / f	14.11.01 / 13.11.01	HAUSDORF / KUHN I.	639143
Anz. / Index	gepr. am / geänd. am	gepr. von / geänd. von	Ä.M.-Nr.

1999	Tag	Name
Gez.	14.01.	KUHN I.
Gepr.	14.01.	HAUSDORF
Norm.		

Werkstoff

Teile-Nr.

Fertigmaße

Rauheitsklasse DIN ISO 1302

µm	N2	N3	N4	N5	N6	N7	N8	N9	N10
Rz	0,25	0,5	1	2	4	8	16	32	63
Ra	0,05	0,1	0,2	0,4	0,8	1,6	3,2	6,3	12,5

Maßstab

Modell-Nr.

Zeichnung besteht aus 7 Blatt | Blatt: 6

Masse 0.000 kg

HYDAC FILTERTECHNIK

Auftrag-Nr.

Benennung

Back flush filter
RF3-2.5/8/ANSI

Teile-Code-Nr.
07 715 972 2 03018791

Ers. für:

Ers. durch:

Informationskopie des Originals
Computererstellte Zeichnung (CAD)

APPENDIX C
Hydraulics Calculations for the Full-Barrier Strategy for the SBA System

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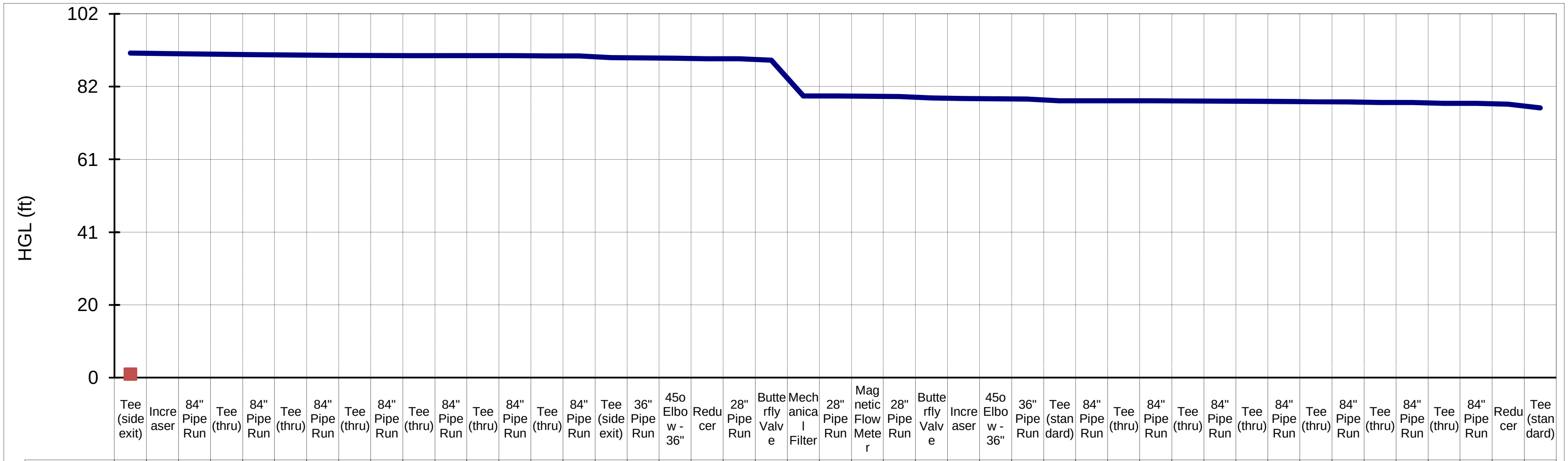
Flowrate 120.00 MGD
C-value 130

Line #	Flow (mgd)	Diameter (in.)	Length (ft)	Velocity (ft/s)	Velocity Head	C	k (ea)	Friction Loss	Minor Loss (total)		Head Loss (total)	EGL	HGL	Description
												92.28	92.28	Anticipated system pressure of 40 psi CL of SBA pipe is at elevation ?? ft
1	120.00	72		6.56	0.669	130	1.8		1.203		1.20	91.08	90.41	Tee (side exit)
2	120.00	72		6.56	0.669	130	0.25		0.167		0.17	90.91	90.24	Increaser
3	120.00	84	25.5	4.82	0.361	130		0.018			0.02	90.89	90.53	84" Pipe Run
4	120.00	84		4.82	0.361	130	0.6		0.217		0.22	90.67	90.31	Tee (thru)
5	120.00	84	6	4.82	0.361	130		0.004			0.00	90.67	90.31	84" Pipe Run
6	100.00	84		4.02	0.251	130	0.6		0.150		0.15	90.52	90.27	Tee (thru)
7	100.00	84	6	4.02	0.251	130		0.003			0.00	90.52	90.27	84" Pipe Run
8	80.00	84		3.21	0.160	130	0.6		0.096		0.10	90.42	90.26	Tee (thru)
9	80.00	84	6	3.21	0.160	130		0.002			0.00	90.42	90.26	84" Pipe Run
10	60.00	84		2.41	0.090	130	0.6		0.054		0.05	90.37	90.28	Tee (thru)
11	60.00	84	6	2.41	0.090	130		0.001			0.00	90.37	90.28	84" Pipe Run
12	40.00	84		1.61	0.040	130	0.6		0.024		0.02	90.35	90.31	Tee (thru)
13	40.00	84	6	1.61	0.040	130		0.001			0.00	90.35	90.31	84" Pipe Run
14	20.00	84		0.80	0.010	130	0.6		0.006		0.01	90.34	90.33	Tee (thru)
15	20.00	84	6	0.80	0.010	130		0.000			0.00	90.34	90.33	84" Pipe Run
16	20.00	36		4.37	0.297	130	1.8		0.535		0.53	89.81	89.51	Tee (side exit)
17	20.00	36	11	4.37	0.297	130		0.017			0.02	89.79	89.49	36" Pipe Run
18	20.00	36		4.37	0.297	130	0.35		0.104		0.10	89.69	89.39	45° Elbow - 36"
19	20.00	28		7.23	0.812	130	0.25		0.203		0.20	89.49	88.68	Reducer
20	20.00	28	2	7.23	0.812	130		0.011			0.01	89.48	88.67	28" Pipe Run
21	20.00	28		7.23	0.812	130	0.46		0.373		0.37	89.11	88.30	Butterfly Valve
22	20.00	28		7.23	0.812						10.00	79.11	78.30	Mechanical Filter
23	20.00	28	12	7.23	0.812	130		0.064			0.06	79.05	78.24	28" Pipe Run
24	20.00	28		7.23	0.812	130	0.1		0.081		0.08	78.97	78.16	Magnetic Flow Meter
25	20.00	28	9	7.23	0.812	130		0.048			0.05	78.92	78.11	28" Pipe Run
26	20.00	28		7.23	0.812	130	0.46		0.373		0.37	78.55	77.74	Butterfly Valve
27	20.00	28		7.23	0.812	130	0.25		0.203		0.20	78.35	77.54	Increaser
28	20.00	36		4.37	0.297	130	0.35		0.104		0.10	78.25	77.95	45° Elbow - 36"
29	20.00	36	16.25	4.37	0.297	130		0.026			0.03	78.22	77.92	36" Pipe Run
30	20.00	36		4.37	0.297	130	1.6		0.475		0.48	77.74	77.44	Tee (standard)
31	20.00	84	6	0.80	0.010	130		0.000			0.00	77.74	77.73	84" Pipe Run
32	40.00	84		1.61	0.040	130	0.6		0.024		0.02	77.72	77.68	Tee (thru)
33	40.00	84	6	1.61	0.040	130		0.001			0.00	77.72	77.68	84" Pipe Run
34	60.00	84		2.41	0.090	130	0.6		0.054		0.05	77.67	77.58	Tee (thru)
35	60.00	84	6	2.41	0.090	130		0.001			0.00	77.67	77.58	84" Pipe Run
36	80.00	84		3.21	0.160	130	0.6		0.096		0.10	77.57	77.41	Tee (thru)
37	80.00	84	6	3.21	0.160	130		0.002			0.00	77.57	77.41	84" Pipe Run
38	100.00	84		4.02	0.251	130	0.6		0.150		0.15	77.42	77.17	Tee (thru)
39	100.00	84	6	4.02	0.251	130		0.003			0.00	77.42	77.17	84" Pipe Run
40	120.00	84		4.82	0.361	130	0.6		0.217		0.22	77.20	76.84	Tee (thru)
41	120.00	84	6	4.82	0.361	130		0.004			0.00	77.20	76.84	84" Pipe Run
42	120.00	84		4.82	0.361	130	0.6		0.217		0.22	76.98	76.62	Tee (thru)
43	120.00	84	25.5	4.82	0.361	130		0.018			0.02	76.96	76.60	84" Pipe Run
44	120.00	72		6.56	0.669	130	0.25		0.167		0.17	76.79	76.12	Reducer
45	120.00	72		6.56	0.669	130	1.6		1.070		1.07	75.72	75.05	Tee (standard)
46											16.56		75.05	CL of SBA pipe is ?? Ft

Notes:



	Tee (side exit)	Increaser	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run
EGL	91.0	90.9	90.8	90.6	90.6	90.5	90.5	90.4	90.4	90.3	90.3	90.3	90.3	90.3	90.3
Ground	1														

	Tee (side exit)	36" Pipe Run	45o Elbow - 36"	Reducer	28" Pipe Run	Butterfly Valve	Mechanical Filter	28" Pipe Run	Magnetic Flow Meter	28" Pipe Run	Butterfly Valve	Increaser	45o Elbow - 36"	36" Pipe Run	Tee (standard)
EGL	89.8	89.7	89.6	89.4	89.4	89.1	79.1	79.0	78.9	78.9	78.5	78.3	78.2	78.2	77.7
Ground															

	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Tee (thru)	84" Pipe Run	Reducer	Tee (standard)
EGL	77.7	77.7	77.7	77.6	77.6	77.5	77.5	77.4	77.4	77.2	77.2	76.9	76.9	76.7	75.7
Ground															

APPENDIX D
Laboratory Report for Water Samples Collected on March 16, 2011

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Curtis & Tompkins, Ltd.
Analytical Laboratories, Since 1878

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 226655
ANALYTICAL REPORT

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118

Project : 91452011.0000
Location : Invasive Mussels
Level : II

Sample ID	Lab ID
SBA TERMINAL TANK	226655-001
PACHECO REGULATING TANK	226655-002

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: ______________________
Project Manager

Date: 03/30/2011

NELAP # 01107CA

CASE NARRATIVE

Laboratory number:	**226655**
Client:	**Santa Clara Valley Water District**
Project:	**91452011.0000**
Location:	**Invasive Mussels**
Request Date:	**03/16/11**
Samples Received:	**03/16/11**

This data package contains sample and QC results for two water samples, requested for the above referenced project on 03/16/11. The samples were received cold and intact.

Total Suspended Solids (TSS) (SM2540D):

No analytical problems were encountered.

Particle Size (ASTM):

PTS Laboratories, Inc in Santa Fe Springs, CA performed the analysis (not NELAP certified). Please see the PTS Laboratories, Inc case narrative.

Santa Clara Valley Water District
PO # 00000 16496

CHAIN OF CUSTODY

Curtis & Tompkins Laboratories
ENVIRONMENTAL ANALYTICAL TESTING LABORATORY
In Business Since 1878

2323 Fifth Street
Berkeley, CA 94710

Phone (510) 486-0900
Fax (510) 486-0532

C&T LOGIN # 226655

Page 1 of 1
Chain of Custody # ______

Project No: 9145 2011.0000
Project Name: Invasive Mussels
EDD Format: Report Level: ☒ II ☐ III ☐ IV
Turnaround Time: ☐ RUSH ______ ☒ Standard

Sampler: Megan Gunvalson
Report To: Laura Young
Company: Santa Clara Valley Water Dist
Telephone: 408.265.2607 X 2461
Email: LYoung@valleywater.org

Lab No.	Sample ID.	SAMPLING		MATRIX			# of Containers	CHEMICAL PRESERVATIVE					ANALYTICAL REQUEST		
		Date Collected	Time Collected	Water	Solid			HCl	H2SO4	HNO3	NaOH	None	TSS SM2540D		Particle Size Distribution in Water ASTM D4222
	SBA Terminal Tank	15 March 2011	1150	X			2					X	X		X
	Pacheco Regulating Tank	16 March 2011	1000	X			2					X	X		X

Notes:

SAMPLE RECEIPT
☒ Intact
☐ Cold
☒ On Ice
☐ Ambient

RELINQUISHED BY:
DATE: 3/16/11 TIME: 1410
DATE: TIME:
DATE: TIME:

RECEIVED BY:
DATE: 3/16/11 TIME: 1410
DATE: TIME:
DATE: TIME:

COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login # 226655 Date Received 3/16/11 Number of coolers 1
Client SCVWD Project INVASIVE MUSSELS

Date Opened 3/16/11 By (print) M. VILLANUEVA (sign)
Date Logged in 3/16/11 By (print) (sign)

1. Did cooler come with a shipping slip (airbill, etc) YES [✓ NO]
   Shipping info

2A. Were custody seals present? ... ☐ YES (circle) on cooler on samples ☐ [✓ NO]
   How many Name Date

2B. Were custody seals intact upon arrival? YES NO [✓ N/A]

3. Were custody papers dry and intact when received? [✓ YES] NO

4. Were custody papers filled out properly (ink, signed, etc)? [✓ YES] NO

5. Is the project identifiable from custody papers? (If so fill out top of form) [✓ YES] NO

6. Indicate the packing in cooler: (if other, describe)

☐ Bubble Wrap ☐ Foam blocks ☐ Bags ☑ None
☐ Cloth material ☐ Cardboard ☐ Styrofoam ☐ Paper towels

7. Temperature documentation:

Type of ice used: ☑ Wet ☐ Blue/Gel ☐ None Temp(°C)

☑ Samples Received on ice & cold without a temperature blank

☐ Samples received on ice directly from the field. Cooling process had begun

8. Were Method 5035 sampling containers present? YES [✓ NO]
   If YES, what time were they transferred to freezer?

9. Did all bottles arrive unbroken/unopened? [✓ YES] NO

10. Are samples in the appropriate containers for indicated tests? [✓ YES] NO

11. Are sample labels present, in good condition and complete? [✓ YES] NO

12. Do the sample labels agree with custody papers? [✓ YES] NO

13. Was sufficient amount of sample sent for tests requested? [✓ YES] NO

14. Are the samples appropriately preserved? YES NO [✓ N/A]

15. Are bubbles > 6mm absent in VOA samples? YES NO [✓ N/A]

16. Was the client contacted concerning this sample delivery? YES [✓ NO]
   If YES, Who was called? By Date:

COMMENTS

SOP Volume: Client Services
Section: 1.1.2
Page: 1 of 1

Rev. 6 Number 1 of 3
Effective: 23 July 2008
Z:\qc\forms\checklists\Cooler Receipt Checklist_rv6.doc

Total Suspended Solids (TSS)

Lab #:	226655	Location:	Invasive Mussels
Client:	Santa Clara Valley Water District	Prep:	METHOD
Project#:	91452011.0000	Analysis:	SM2540D
Analyte:	Total Suspended Solids	Batch#:	173017
Matrix:	Water	Received:	03/16/11
Units:	mg/L	Analyzed:	03/22/11
Diln Fac:	1.000		

Field ID	Type	Lab ID	Result	RL	Sampled
SBA TERMINAL TANK	SAMPLE	226655-001	10	5	03/15/11
PACHECO REGULATING TANK	SAMPLE	226655-002	ND	5	03/16/11
	BLANK	QC584752	ND	5	

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Total Suspended Solids (TSS)

Lab #:	226655	Location:	Invasive Mussels
Client:	Santa Clara Valley Water District	Prep:	METHOD
Project#:	91452011.0000	Analysis:	SM2540D
Analyte:	Total Suspended Solids	Diln Fac:	1.000
Field ID:	ZZZZZZZZZZ	Batch#:	173017
MSS Lab ID:	226649-003	Sampled:	03/16/11
Matrix:	Water	Received:	03/16/11
Units:	mg/L	Analyzed:	03/22/11

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
LCS	QC584753		50.00	55.00	110	80-120		
MS	QC584754	19.00	50.00	73.00	108	58-126		
MSD	QC584755		50.00	81.00	124	58-126	10	28

RPD= Relative Percent Difference

Laboratory Job Number 226655

Subcontracted Products

PTS Laboratories, Inc

PARTICLE SIZE SUMMARY

(METHODOLOGY: ASTM D4464M)

PROJECT NAME: N/A
PROJECT NO: 226655

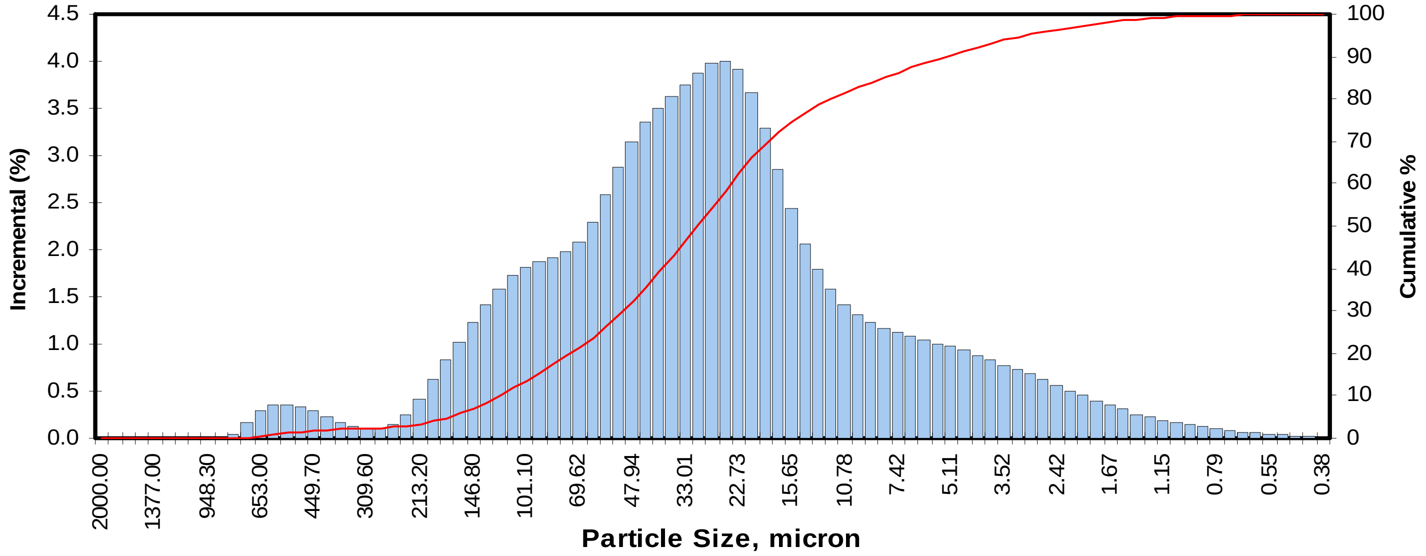
Sample ID	Matrix	Median Grain Size, micron (1)	CUMULATIVE PERCENT GREATER THAN Distribution percent, microns 5%	10%	16%	25%	40%	50%	60%	75%	84%	90%	95%
SBA TERMINAL TANK	Aqueous	30.466	174.106	122.774	90.087	60.838	39.093	30.466	24.010	15.347	8.895	5.308	2.766
PACHECO REGULATING TANK	Aqueous	BELOW DL: INSUFFICIENT CONCENTRATION FOR ANALYSIS A DISTRIBUTION CURVE COULD NOT BE GENERATED											

(1) Based on Trask Median
DL = Detection Limits

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Curtis & Tompkins	**PTS File No:**	41171
Project:	N/A	**Sample ID:**	SBA TERMINAL TANK
Project No:	226655	**Matrix:**	Aqueous



Particle Diameter, micron	Particle Distribution Incremental percent	Particle Distribution Cumulative percent
2000.00	0.00	0.0
1822.00	0.00	0.0
1660.00	0.00	0.0
1512.00	0.00	0.0
1377.00	0.00	0.0
1255.00	0.00	0.0
1143.00	0.00	0.0
1041.00	0.00	0.0
948.30	0.00	0.0
863.90	0.00	0.0
786.90	0.04	0.0
716.90	0.16	0.2
653.00	0.29	0.5
594.90	0.36	0.9
541.90	0.35	1.2
493.60	0.33	1.5
449.70	0.29	1.8
409.60	0.23	2.1
373.10	0.17	2.2
339.90	0.12	2.3
309.60	0.09	2.4
282.10	0.10	2.5
256.90	0.15	2.7
234.10	0.25	2.9
213.20	0.42	3.4
194.20	0.62	4.0
176.90	0.83	4.8
161.20	1.03	5.8
146.80	1.23	7.1
133.70	1.42	8.5
121.80	1.59	10.1
111.00	1.73	11.8
101.10	1.82	13.6
92.10	1.88	15.5
83.90	1.91	17.4
76.43	1.97	19.4
69.62	2.09	21.5
63.42	2.30	23.8
57.77	2.58	26.4
52.63	2.88	29.2
47.94	3.15	32.4
43.67	3.36	35.7
39.78	3.50	39.2
36.24	3.62	42.9
33.01	3.74	46.6
30.07	3.87	50.5
27.39	3.97	54.4
24.95	4.01	58.5
22.73	3.91	62.4
20.71	3.67	66.0
18.86	3.29	69.3
17.18	2.86	72.2
15.65	2.44	74.6
14.26	2.07	76.7
12.99	1.79	78.5
11.83	1.58	80.1
10.78	1.42	81.5
9.82	1.31	82.8
8.94	1.23	84.0
8.15	1.17	85.2
7.42	1.13	86.3
6.76	1.09	87.4
6.16	1.05	88.5
5.61	1.01	89.5
5.11	0.97	90.4
4.66	0.93	91.4
4.24	0.88	92.3
3.86	0.84	93.1
3.52	0.78	93.9
3.21	0.73	94.6
2.92	0.68	95.3
2.66	0.62	95.9
2.42	0.56	96.5
2.21	0.51	97.0
2.01	0.45	97.4
1.83	0.40	97.8
1.67	0.35	98.2
1.52	0.31	98.5
1.385	0.260	98.7
1.261	0.230	99.0
1.149	0.190	99.2
1.047	0.160	99.3
0.954	0.140	99.5
0.869	0.120	99.6
0.791	0.097	99.7
0.721	0.081	99.8
0.657	0.067	99.8
0.598	0.054	99.9
0.545	0.043	99.9
0.496	0.033	100.0
0.452	0.022	100.0
0.412	0.015	100.0
0.375	0.009	100.0
TOTALS:	**100.01**	**100.0**

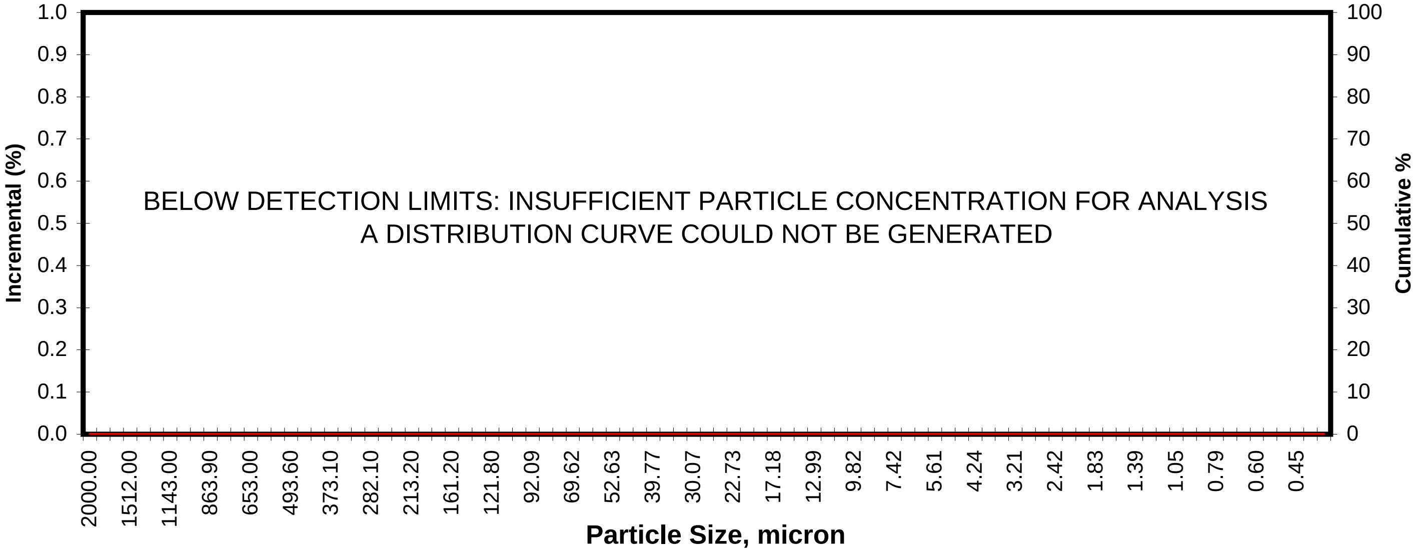
Measure	Trask	Inman
Median, mm	0.0305	0.0305
Median, micron	30.466	30.466
Mean, mm	0.0381	0.0283
Mean, micron	38.092	28.308
Sorting	1.9910	1.670
Skewness	1.0029	0.063
Kurtosis	0.1936	0.789

Cumulative Percent greater than Distribution percent	Particle Size Micron	Particle Size Millimeters
5	174.106	0.1741
10	122.774	0.1228
16	90.087	0.0901
25	60.838	0.0608
40	39.093	0.0391
50	30.466	0.0305
60	24.010	0.0240
75	15.347	0.0153
84	8.895	0.0089
90	5.308	0.0053
95	2.766	0.0028

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Curtis & Tompkins	**PTS File No:**	41171
Project:	N/A	**Sample ID:**	PACHECO REGULATING TANK
Project No:	226655	**Matrix:**	Aqueous



BELOW DETECTION LIMITS: INSUFFICIENT PARTICLE CONCENTRATION FOR ANALYSIS
A DISTRIBUTION CURVE COULD NOT BE GENERATED

Particle Diameter, micron	Particle Distribution	
	Incremental percent	Cumulative percent
2000.00	0.00	0.0
1822.00	0.00	0.0
1660.00	0.00	0.0
1512.00	0.00	0.0
1377.00	0.00	0.0
1255.00	0.00	0.0
1143.00	0.00	0.0
1041.00	0.00	0.0
948.20	0.00	0.0
863.90	0.00	0.0
786.90	0.00	0.0
716.90	0.00	0.0
653.00	0.00	0.0
594.90	0.00	0.0
541.90	0.00	0.0
493.60	0.00	0.0
449.70	0.00	0.0
409.60	0.00	0.0
373.10	0.00	0.0
339.80	0.00	0.0
309.60	0.00	0.0
282.10	0.00	0.0
256.80	0.00	0.0
234.10	0.00	0.0
213.20	0.00	0.0
194.20	0.00	0.0
176.80	0.00	0.0
161.20	0.00	0.0
146.80	0.00	0.0
133.70	0.00	0.0
121.80	0.00	0.0
111.00	0.00	0.0
101.10	0.00	0.0
92.09	0.00	0.0
83.90	0.00	0.0
76.43	0.00	0.0
69.62	0.00	0.0
63.41	0.00	0.0
57.77	0.00	0.0
52.63	0.00	0.0
47.93	0.00	0.0
43.66	0.00	0.0
39.77	0.00	0.0
36.24	0.00	0.0
33.00	0.00	0.0
30.07	0.00	0.0
27.38	0.00	0.0
24.95	0.00	0.0
22.73	0.00	0.0
20.70	0.00	0.0
18.86	0.00	0.0
17.18	0.00	0.0
15.65	0.00	0.0
14.26	0.00	0.0
12.99	0.00	0.0
11.83	0.00	0.0
10.78	0.00	0.0
9.82	0.00	0.0
8.94	0.00	0.0
8.15	0.00	0.0
7.42	0.00	0.0
6.76	0.00	0.0
6.16	0.00	0.0
5.61	0.00	0.0
5.11	0.00	0.0
4.66	0.00	0.0
4.24	0.00	0.0
3.86	0.00	0.0
3.52	0.00	0.0
3.21	0.00	0.0
2.92	0.00	0.0
2.66	0.00	0.0
2.42	0.00	0.0
2.21	0.00	0.0
2.01	0.00	0.0
1.83	0.00	0.0
1.67	0.00	0.0
1.52	0.00	0.0
1.385	0.000	0.0
1.261	0.000	0.0
1.149	0.000	0.0
1.047	0.000	0.0
0.953	0.000	0.0
0.869	0.000	0.0
0.791	0.000	0.0
0.721	0.000	0.0
0.657	0.000	0.0
0.598	0.000	0.0
0.545	0.000	0.0
0.496	0.000	0.0
0.452	0.000	0.0
0.412	0.000	0.0
0.375	0.000	0.0
TOTALS:	**0.00**	**0.0**

Measure	Trask	Inman
Median, mm	N/A	N/A
Median, micron	N/A	N/A
Mean, mm	N/A	N/A
Mean, micron	N/A	N/A
Sorting	N/A	N/A
Skewness	N/A	N/A
Kurtosis	N/A	N/A

Cumulative Percent greater than

Distribution percent	Particle Size	
	Micron	Millimeters
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A

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APPENDIX E
Parkson Lamella Gravity Settler

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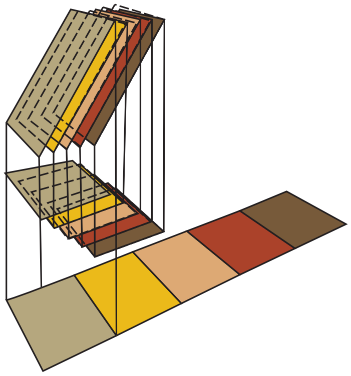
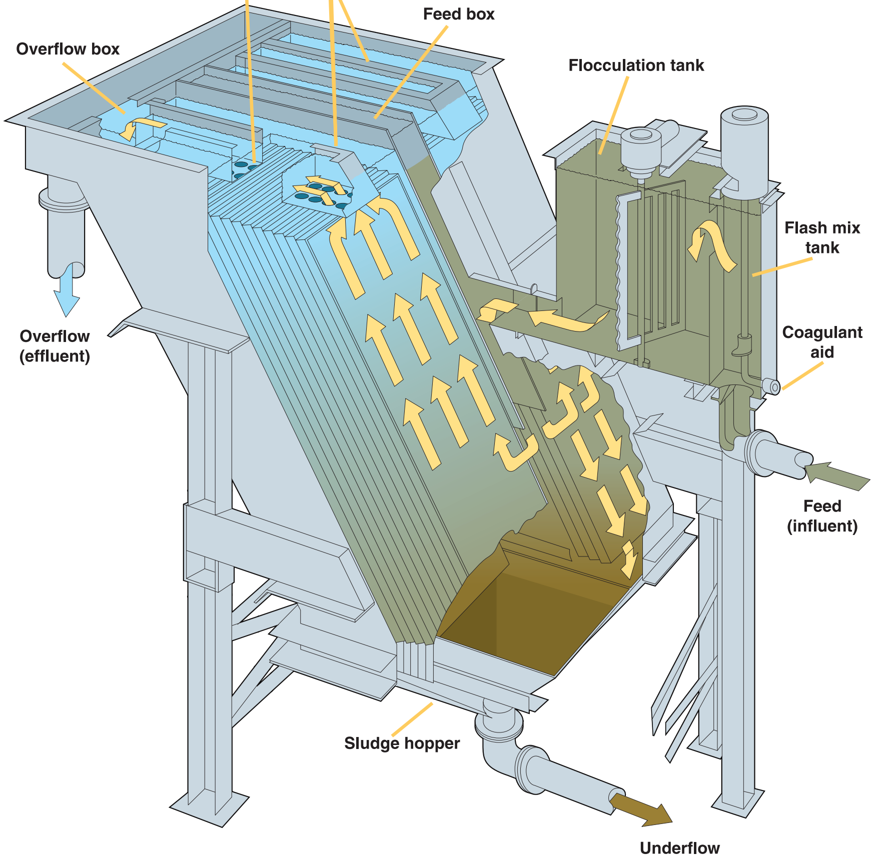
Lamella® Gravity Settler

Inclined Plate Settler

Conventional clarification equipment requires 10 times more physical area to even begin to approach the same settling capacity of a Lamella® Gravity Settler. This means faster settling in one tenth the space because the effective gravity settling area of the inclined plate design equals each plate's area projected on a horizontal surface. Up to ten square feet of settling area becomes available for each square foot of physical area occupied by the unit. Loading rates normally used for the design of conventional settlers can be applied to the sizing of a Lamella settler by substituting projected area for the surface settling area of a conventional clarifier.



The most significant aspect of the gravity settler's design is its available settling area



Lamella® Gravity Settler package unit

Lamella® Gravity Settler/Thickener

The compact design minimizes hydraulic disturbances caused by wind or temperature changes. Balanced flow distribution ensures equal flow to each plate and across the plate surface area preventing short-circuiting.

Units and plate packs arrive at the job site factory assembled which reduces installation time and lowers installed costs. Minimal moving parts means low maintenance costs.

Principle of Operation

Influent enters the Lamella® Gravity Settler and flows downward through the inlet chamber in the center of the unit and enters the plates through side-entry plate slots. The countercurrent design, unlike typical bottom feed designs, reduces the risk of disturbing previously settled solids.

As the liquid flows upward, the solids settle on the inclined, parallel plates and slide into the sludge hopper at the bottom. Further thickening of the sludge is achieved in the hopper due to compression in the quiescent zone achieved by the side feed design.

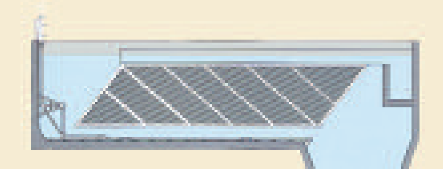
The clarified liquid leaves the plate assembly through orifices or weirs at the top and is distributed into collection channels leading to the clarified water outlet. This creates a pressure drop across the collection channels which ensures uniform flow distribution across the plates in order to utilize the full area for settling.

Three Standard Designs

The LGS design is a self-contained, packaged settling unit with a conical sludge hopper and optional sludge scraper.

The LGST design is a high-rate gravity settler combined with a circular, picket-fence sludge thickener/scraper. The settler section utilizes the same counter-current flow principle and the inclined plate design used in packaged Lamella Gravity Settlers. The LGST handles flow rates and/or solids loadings beyond the capacity of a packaged settler unit. It produces unprecedented sludge concentrations and provides sludge storage providing flexibility for further sludge dewatering equipment. Underflow sludge concentrations are up to 5 times higher.

Lamella® plate packs in concrete basin



The Lamella® Gravity Settler teamed up with the SuperScraper sludge removal system

In addition to self-contained designs, the LGS plate pack assembly is appropriate for installation in concrete basins or steel tanks. This can be a low maintenance, cost-effective means of increasing existing basin capacity. The plate pack assemblies operate in the same manner as the free-standing units. The basins can be equipped with Parkson's SuperScraper™ hydraulic sludge scraper for sludge removal and thickening.

Both designs can be equipped with a flash mixing and flocculation tank upstream of the inlet pipe. The chemical flocculant is added in a separate flash mixing compartment.

Lamella Applications

- Potable water
- Filter Backwash
- Industrial process water
- Clarification
- Effluent treatment in Pulp and Paper
- Biological purification processes
- Washwater recirculation systems
- Wet-scrubbed and slaking effluents

Process Knowledge

The knowledge gained from 4,000 installations, 6,000 laboratory tests, and 900 pilot tests is the Parkson guarantee.

Parkson™
Treating Water Right

Fort Lauderdale Chicago Montreal Dubai

ISO 9001:2008 Certified
Quality Management System

AN AXEL JOHNSON INC. COMPANY

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technology@parkson.com

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FSC Mixed Sources
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LAMELLA® GRAVITY SETTLER

PRELIMINARY BUDGET SIZING
SANTA CLARA, CA

APPLICATION: **FILTER BACKWASH**

DESIGN DATA:

Flow:	420	USGPM =	0.6	USmgd	pH	
Feed quality:	200	mg/L suspended solids			Temp:	F
Overflow quality:	20	mg/L suspended solids			Chlorides:	mg/L

One (1) model LGST 1120/55 LAMELLA® GRAVITY SETTLER
complete with flashmixer/floculator

Plate area:	per unit:	1120	ft²	Total:	1120	ft²
Effective Settling area:	per unit:	896	ft²	Total:	896	ft²
Loading rate:		0.47	USgpm/ft²			
Sludge hopper capacity each:		4155	US gallons			
Expected underflow solids concentratior		1 to 1	%wt			
Expected underflow (continious):		7.6 to 15.1	USGPM			

Flashmixer:	vol. each:	70	gal	Retention time:	10.0	sec
	drive:	0.5 HP constant speed drive motor 230/460V / 3 ph / 60 Hz				
Flocculator:	vol. each:	500	gal	Retention time:	1.19	min
	drive:	0.5 HP variable speed drive 230/460V / 3 ph / 60 Hz				
Thickener:	Drive:	0.25 HP variable speed drive 230/460V / 3 ph / 60 Hz				
	Stall Torque	511 lbs. ft				

LGS unit designed for Seismic Zone 2 UBC - 97

Shipping weight, each:	See drawing
Operating weight, each:	See drawing
Overall dimensions, each:	See drawing
Reference Drawing:	

MATERIALS: Epoxy Coated Carbon Steel tank
Ortho FRP settling plates

BUDGET PRICING: **$205,000** USD
FOB Point of Manufacture, freight allowed to jobsite, duty and brokerage included, taxes extra.
Start-Up visit including travel and travel expenses not included.

SHIPMENT: 18 to 20 weeks after purchase.

PRICE VALIDITY: **30 DAYS**

R. Troupe
RM: S. Young
1-Mar-11

1401 W Cypress Creek Rd., Fort Lauderdale, FL 33309
tel: (954) 974-6610 fax: (954) 974-6182

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APPENDIX F
OPCC for the Full-Barrier Strategy for the SBA System

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SANTA CLARA VALLEY WATER DISTRICT
SCVWD
Invasive Mussel Control Measures at Imported Water Intakes, Full-Barrier Strategy for the SBA System

Opinion of Probable Construction Costs

Currency: USD-United States-MARCH 2011 Dollar

Grand Total Price: $ 12,277,000

Item #	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments/Assumptions
A		**South Bay Aqueduct System**	1	LS	$5,672,950	**$5,672,950**	
A.1		**Near Santa Clara Meter Vault**	1	LS	$5,246,150		**$5,246,150**
1	P	Site Work	1	LS	$50,000.00	$50,000	Allowance for grading, landscaping, fence, erosion control etc
2	P	Install ClO2 Generator	1	EA	$251,000.00	$251,000	Quote ClO2 Generator $236K
3	P	Valve Allowance for Minor Piping	1	LS	$5,000.00	$5,000	
4	P	Construct Chemical Storage Building	4,800	SF	$120.00	$576,000	CMU building
5	P	Install Chemical Tanks	6	EA	$18,000.00	$108,000	FRP 2ea x 5K + 4ea x 4K gal
6	P	Install 4" ClO2 Feed line - Buried	150	LF	$74.00	$11,100	Incl earthwork, 3' min cover
7	P	Filter Unit Foundation and Concrete Pad	140	CY	$400.00	$56,000	50' x 74' x 12"
8	P	Pipes, Valves and Flow Meters (incl Supports) - Connection to Filter Units	7	EA	$95,000.00	$665,000	182' x 36"pipe, 154' x 28"pipe, 14eax 28"BFV, 7eax28"Mag Flow Meter+ pipe supports + fittings
9	P	Install Hydac Filter Units - 6-Bar Units	7	EA	$200,000.00	$1,400,000	Quote SS 6-bar each + 64 crewhr (5men+crane)
10	P	Tie in 6' dia for Filter Piping	2	EA	$57,000.00	$114,000	32 crewhr (5men+weld/oxy-ace +crane) +72" Tee x 2ea
11	P	Install 7' dia Piping for Filters	120	LF	$1,300.00	$156,000	Incl earthwork, 4' min cover
12	P	Install 4" Backwash & Clarifier Overflow	800	LF	$40.00	$32,000	Incl earthwork, 3' min cover
13	P	Install Clarifiers and Foundation	2	EA	$220,000.00	$440,000	Quote + 16 crewhr (5men+crane) + 32cy conc+ anchors
14	S	Metering Pump Enclosure	91	SF	$150.00	$13,650	7' x 13' incl earthwork
15	P	Install Metering Pumps	2	EA	$12,000.00	$24,000	Mechanical Actuated Diaphragm Pump ProMinent g/L 1602
16	P	Concrete Foundation, Pad and Bundwall for Storage Tanks	5	CY	$1,000.00	$5,000	13' x 8'
17	P	Install Storage Tanks	2	EA	$3,000.00	$6,000	Sodium bisulfite storage tanks for clarifier underflow (3' dia. X 3' tall), Aluminum sulfate storage tanks (4' dia. X 3' tall)
18	P	Install 1" dia Chemical Feedline and Clarifier Underflow	130	LF	$20.00	$2,600	incl earthworks and fittings
19	P	Construct Concrete Vault 15' x 16' x 15'deep	1	LS	$47,000.00	$47,000	15' x 16' x 15'deep incl earthwork and shoring
20	P	Install 72" BF Valves and 12" Outlet Pipe Inside Valve Vault	1	LS	$333,000.00	$333,000	Incl cutting (E) 72" pipe, 2ea x72" BFV & 12" outlet pipe
21	P	Construct Clarifier Underflow Storage Basin	1,792	SF	$150.00	$268,800	32'x 28' x 16' x 2ea
22	P	Install Chemical Inline Mixer	1	EA	$44,000.00	$44,000	
23	P	Allowance for Pipe Encasements	100	CY	$400.00	$40,000	incl earthwork
24	P	Furnish Office Trailer for Plant Operator	1	EA	$40,000.00	$40,000	12' x 50'
25	S	Electrical and Instrumentation	1	LS	$558,000.00	$558,000	12.0%
A.2		**Piedmont Valve Yard**	1	LS	$248,800		**$248,800**
1	P	Site Work	1	LS	$25,000.00	$25,000	Allowance for grading, landscaping, fence, erosion control etc
2	S	Metering Pump Enclosure	78	SF	$150.00	$11,700	6' x 13' incl earthwork
3	P	Install Metering Pumps	2	EA	$12,000.00	$24,000	Mechanical Actuated Diaphragm Pump ProMinent g/L 1605
4	P	Concrete Foundation, Pad and Bundwall for Storage Tanks	56	CY	$1,000.00	$56,000	1520sf x10"
5	P	Install Storage Tanks	3	EA	$21,000.00	$63,000	Sodium Bisulfite Storage Tank - 7600 gal ea
6	P	Install 1" dia Chemical Feedline	100	LF	$21.00	$2,100	incl earthworks, fittings, 45' U/G piping
7	P	Install Chemical Inline Mixer	1	EA	$44,000.00	$44,000	Quote + 1dayx5men + eq installation
8	S	Electrical and Instrumentation	1	LS	$23,000.00	$23,000	10%
A.3		**After SBA Terminal Tank**	1	LS	$178,000		**$178,000**
1	P	Site Work	1	LS	$25,000.00	$25,000	Allowance for grading, landscaping, fence, erosion control etc
2	S	Metering Pump Enclosure	78	SF	$150.00	$11,700	6' x 13' incl earthwork
3	P	Install Metering Pumps	2	EA	$12,000.00	$24,000	Mechanical Actuated Diaphragm Pump ProMinent g/L 1605
4	P	Concrete Foundation, Pad and Bundwall for Storage Tanks	38	CY	$1,000.00	$38,000	40' x26'
5	P	Install Storage Tanks	3	EA	$6,000.00	$18,000	Sodium Bisulfite Storage Tank - 4300 gal ea
6	P	Install 1" dia Chemical Feedline	50	LF	$26.00	$1,300	incl earthworks, fittings, 20' U/G piping
7	P	Install Chemical Inline Mixer	1	EA	$44,000.00	$44,000	Quote + 1dayx5men + eq installation
8	S	Electrical and Instrumentation	1	LS	$16,000.00	$16,000	10%
S		**Startup/Commission**				**$14,750**	
1	P	Startup Crew	5	dy	$2,950	$14,750	5 man crew + equip
2	S	Vendor Commissioning	1	ls	$0.00	$0	included above
					Running Subtotal:	**$5,690,000**	
T		**Mobilization/Field Oversight Expenses**				**$581,451**	

Walnut Creek, CA

ECC
5/18/2011

SANTA CLARA VALLEY WATER DISTRICT
SCVWD
Invasive Mussel Control Measures at Imported Water Intakes, Full-Barrier Strategy for the SBA System

Opinion of Probable Construction Costs

Currency: USD-United States-MARCH 2011 Dollar

Grand Total Price: $ 12,277,000

Item #	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments/Assumptions
1	P	Contractor General Conditions (Prime)	1	ls	10%	$505,365	
2	S	Contractor General Conditions (Subcontractor)	1	ls	12%	$76,086	
U		**Parametric Contingency**				**$569,000**	
1	P	Unlisted Items Allowance	1	ls	10.0%	$569,000	
					Running Subtotal:	**$6,840,451**	
V		**Markups**				**$1,474,779**	
1	S	Subcontractor Markups	1	ls	15.0%	**$106,520**	H/O Overheads, Job Fee & Risk (Included above), insur, bond
2	P	Prime Contractor OH&P on Subs	1	ls	5.0%	**$40,833**	ditto
3	P	Prime Contractor OH&P on Self-Perform	1	ls	12.5%	**$766,002**	ditto
4	P	Contractor Insurance Program	1	ls	2.5%	**$193,845**	Performance/Payments Bonds, Genl Liability, & Bldr's Risk
5	P	State Sales Taxes	1	ls	9.25%	**$367,579**	State excise taxes, tariffs, etc. at 50% of project costs.
6	P	Escalation to MPC	1	ls	2.5%	**$0**	Excluded
					Running Subtotal:	**$8,320,000**	Total Estimated Constr Costs w/o contingency
			MU Factor:	1.216			
W		**Project Administration & Management**				**$3,957,000**	
1	--	Construction Oversight & Mgt	1	ls	7%	**$582,000**	
2	--	Inspection	1	ls	3%	**$250,000**	
3	--	Engineering	1	ls	5%	**$445,000**	
4	--	Permitting	1	ls	3%	**$250,000**	
5	--	Administration/ Legal support	1	ls	5%	**$467,000**	
6	--	Scope Contingency/Market Conditions	1	ls	20%	**$1,963,000**	Design definition/estimating/market allowance
7	--	Owner's Construction Contingency/Mgt Reserve	1	ls	0%	**$0**	Excluded, allowance for changed field conditions
					Grand Total:	**$12,277,000**	Total Estimated Constr Costs w/ Contingency
				Cost Range:	**$8,270,000**	**$19,490,000**	Per AACE cost estimate guidelines
					Total Contingency:	**$467,000**	4%

Notes:

1) This OPCC is classified as a Class 5 cost estimate per AACE guidelines. Stated accuracy range = -30% to + 65%
2) Pricing basis = 1st Qtr 2011, escalation to midpoint of construction is not included.
3) P=Prime, S=Subcontractor
4) Prices are inclusive of labor, materials and equipment unless otherwise noted.
5) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
6) Owner soft costs and project management expenses included.
6) Capital spare parts not included.
7) Special Inspections not included.
8) Permit Fees included

OPCC Disclaimer

The client hereby acknowledges that MWH has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that MWH cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from MWH's good faith Class 5 OPCC

AACE International CLASS 5 Cost Estimate – Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 2% to 10% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.(AACE International Recommended Practices and Standards).

APPENDIX G
Hydraulics Calculations for the Full-Barrier Strategy for the SLR System

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Flowrate	310.00	MGD
C-value	130	

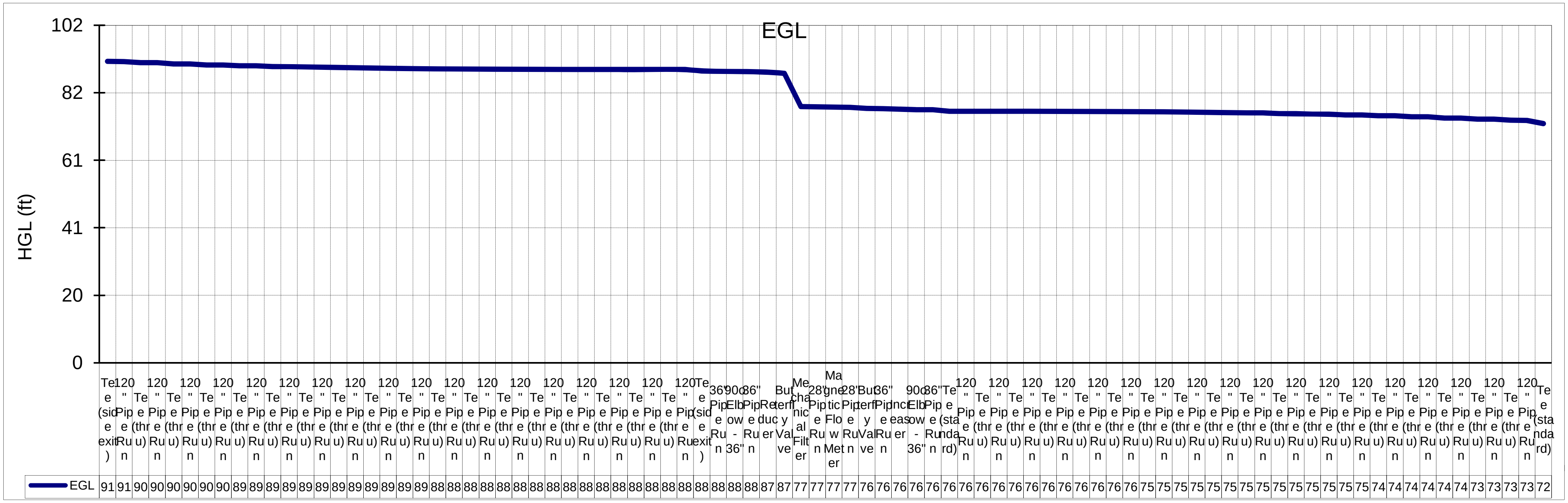
Line #	Flow (mgd)	Diameter (in.)	Length (ft)	Velocity (ft/s)	Velocity Head	C	k (ea)	Friction Loss	Minor Loss (total)		Head Loss (total)	EGL	HGL	Description
												92.28	92.28	Anticipated system pressure of 40 psi CL of SBA pipe is at elevation ?? ft
1	310.00	120		6.10	0.578	130	1.8		1.041		1.04	91.24	90.66	Tee (side exit)
2	310.00	120	127.5	6.10	0.578	130		0.092			0.09	91.15	90.57	120" Pipe Run
3	310.00	120		6.10	0.578	130	0.6		0.347		0.35	90.80	90.22	Tee (thru)
4	310.00	120	6.3	6.10	0.578	130		0.005			0.00	90.80	90.22	120" Pipe Run
5	310.00	120		6.10	0.578	130	0.6		0.347		0.35	90.45	89.87	Tee (thru)
6	310.00	120	6.3	6.10	0.578	130		0.005			0.00	90.45	89.87	120" Pipe Run
7	290.63	120		5.72	0.508	130	0.6		0.305		0.30	90.15	89.64	Tee (thru)
8	290.63	120	6.3	5.72	0.508	130		0.004			0.00	90.15	89.64	120" Pipe Run
9	271.25	120		5.34	0.443	130	0.6		0.266		0.27	89.88	89.44	Tee (thru)
10	271.25	120	6.3	5.34	0.443	130		0.004			0.00	89.88	89.44	120" Pipe Run
11	251.88	120		4.96	0.382	130	0.6		0.229		0.23	89.65	89.27	Tee (thru)
12	251.88	120	6.3	4.96	0.382	130		0.003			0.00	89.65	89.27	120" Pipe Run
13	232.50	120		4.58	0.325	130	0.6		0.195		0.20	89.45	89.12	Tee (thru)
14	232.50	120	6.3	4.58	0.325	130		0.003			0.00	89.45	89.12	120" Pipe Run
15	213.13	120		4.20	0.273	130	0.6		0.164		0.16	89.29	89.02	Tee (thru)
16	213.13	120	6.3	4.20	0.273	130		0.002			0.00	89.29	89.02	120" Pipe Run
17	193.75	120		3.81	0.226	130	0.6		0.136		0.14	89.15	88.92	Tee (thru)
18	193.75	120	6.3	3.81	0.226	130		0.002			0.00	89.15	88.92	120" Pipe Run
19	174.38	120		3.43	0.183	130	0.6		0.110		0.11	89.04	88.86	Tee (thru)
20	174.38	120	6.3	3.43	0.183	130		0.002			0.00	89.04	88.86	120" Pipe Run
21	155.00	120		3.05	0.145	130	0.6		0.087		0.09	88.95	88.81	Tee (thru)
22	155.00	120	6.3	3.05	0.145	130		0.001			0.00	88.95	88.81	120" Pipe Run
23	135.63	120		2.67	0.111	130	0.6		0.066		0.07	88.88	88.77	Tee (thru)
24	135.63	120	6.3	2.67	0.111	130		0.001			0.00	88.88	88.77	120" Pipe Run
25	116.25	120		2.29	0.081	130	0.6		0.049		0.05	88.83	88.75	Tee (thru)
26	116.25	120	6.3	2.29	0.081	130		0.001			0.00	88.83	88.75	120" Pipe Run
27	96.88	120		1.91	0.056	130	0.6		0.034		0.03	88.80	88.74	Tee (thru)
28	96.88	120	6.3	1.91	0.056	130		0.001			0.00	88.80	88.74	120" Pipe Run
29	77.50	120		1.53	0.036	130	0.6		0.022		0.02	88.78	88.74	Tee (thru)
30	77.50	120	6.3	1.53	0.036	130		0.000			0.00	88.78	88.74	120" Pipe Run
31	58.13	120		1.14	0.020	130	0.6		0.012		0.01	88.77	88.75	Tee (thru)
32	58.13	120	6.3	1.14	0.020	130		0.000			0.00	88.77	88.75	120" Pipe Run
33	38.75	120		0.76	0.009	130	0.6		0.005		0.01	88.76	88.75	Tee (thru)
34	38.75	120	6.3	0.76	0.009	130		0.000			0.00	88.76	88.75	120" Pipe Run
35	19.38	120		0.38	0.002	130	0.6		0.001		0.00	88.76	88.76	Tee (thru)
36	19.38	120	6.3	0.38	0.002	130		0.000			0.00	88.76	88.76	120" Pipe Run
37	19.38	36		4.24	0.279	130	1.8		0.502		0.50	88.26	87.98	Tee (side exit)
38	19.38	36	6.8	4.24	0.279	130		0.010			0.01	88.25	87.97	36" Pipe Run
39	19.38	36		4.24	0.279	130	0.5		0.139		0.14	88.11	87.83	90° Elbow - 36"
40	19.38	36	7.5	4.24	0.279	130		0.011			0.01	88.10	87.82	36" Pipe Run
41	19.38	28		7.01	0.762	130	0.25		0.190		0.19	87.91	87.15	Reducer
42	19.38	28		7.01	0.762	130	0.46		0.351		0.35	87.56	86.80	Butterfly Valve
43	19.38	28		7.01	0.762						**10.00**	77.56	76.80	Mechanical Filter
44	19.38	28	22	7.01	0.762	130		0.111			0.11	77.45	76.69	28" Pipe Run
45	19.38	28		7.01	0.762	130	0.1		0.076		0.08	77.37	76.61	Magnetic Flow Meter

Line #	Flow (mgd)	Diameter (in.)	Length (ft)	Velocity (ft/s)	Velocity Head	C	k (ea)	Friction Loss	Minor Loss (total)		Head Loss (total)	EGL	HGL	Description
												92.28	92.28	Anticipated system pressure of 40 psi CL of SBA pipe is at elevation ?? ft
46	19.38	28	12.5	7.01	0.762	130		0.063			0.06	77.31	76.55	28" Pipe Run
47	19.38	28		7.01	0.762	130	0.46		0.351		0.35	76.96	76.20	Butterfly Valve
48	19.38	28	7	7.01	0.762	130		0.035			0.04	76.92	76.16	36" Pipe Run
49	19.38	28		7.01	0.762	130	0.25		0.190		0.19	76.73	75.97	Increaser
50	19.38	36		4.24	0.279	130	0.5		0.139		0.14	76.59	76.31	90° Elbow - 36"
51	19.38	36	10.5	4.24	0.279	130		0.016			0.02	76.57	76.29	36" Pipe Run
52	19.38	36		4.24	0.279	130	1.6		0.446		0.45	76.12	75.84	Tee (standard)
53	19.38	120	6.3	0.38	0.002	130		0.000			0.00	76.12	76.12	120" Pipe Run
54	38.75	120		0.76	0.009	130	0.6		0.005		0.01	76.11	76.10	Tee (thru)
55	38.75	120	6.3	0.76	0.009	130		0.000			0.00	76.11	76.10	120" Pipe Run
56	58.13	120		1.14	0.020	130	0.6		0.012		0.01	76.10	76.08	Tee (thru)
57	58.13	120	6.3	1.14	0.020	130		0.000			0.00	76.10	76.08	120" Pipe Run
58	77.50	120		1.53	0.036	130	0.6		0.022		0.02	76.08	76.04	Tee (thru)
59	77.50	120	6.3	1.53	0.036	130		0.000			0.00	76.08	76.04	120" Pipe Run
60	96.88	120		1.91	0.056	130	0.6		0.034		0.03	76.05	75.99	Tee (thru)
61	96.88	120	6.3	1.91	0.056	130		0.001			0.00	76.05	75.99	120" Pipe Run
62	116.25	120		2.29	0.081	130	0.6		0.049		0.05	76.00	75.92	Tee (thru)
63	116.25	120	6.3	2.29	0.081	130		0.001			0.00	76.00	75.92	120" Pipe Run
64	135.63	120		2.67	0.111	130	0.6		0.066		0.07	75.93	75.82	Tee (thru)
65	135.63	120	6.3	2.67	0.111	130		0.001			0.00	75.93	75.82	120" Pipe Run
66	155.00	120		3.05	0.145	130	0.6		0.087		0.09	75.84	75.70	Tee (thru)
67	155.00	120	6.3	3.05	0.145	130		0.001			0.00	75.84	75.70	120" Pipe Run
68	174.38	120		3.43	0.183	130	0.6		0.110		0.11	75.73	75.55	Tee (thru)
69	174.38	120	6.3	3.43	0.183	130		0.002			0.00	75.73	75.55	120" Pipe Run
70	193.75	120		3.81	0.226	130	0.6		0.136		0.14	75.59	75.36	Tee (thru)
71	193.75	120	6.3	3.81	0.226	130		0.002			0.00	75.59	75.36	120" Pipe Run
72	213.13	120		4.20	0.273	130	0.6		0.164		0.16	75.43	75.16	Tee (thru)
73	213.13	120	6.3	4.20	0.273	130		0.002			0.00	75.43	75.16	120" Pipe Run
74	232.50	120		4.58	0.325	130	0.6		0.195		0.20	75.23	74.90	Tee (thru)
75	232.50	120	6.3	4.58	0.325	130		0.003			0.00	75.23	74.90	120" Pipe Run
76	251.88	120		4.96	0.382	130	0.6		0.229		0.23	75.00	74.62	Tee (thru)
77	251.88	120	6.3	4.96	0.382	130		0.003			0.00	75.00	74.62	120" Pipe Run
78	271.25	120		5.34	0.443	130	0.6		0.266		0.27	74.73	74.29	Tee (thru)
79	271.25	120	6.3	5.34	0.443	130		0.004			0.00	74.73	74.29	120" Pipe Run
80	290.63	120		5.72	0.508	130	0.6		0.305		0.30	74.43	73.92	Tee (thru)
81	290.63	120	6.3	5.72	0.508	130		0.004			0.00	74.43	73.92	120" Pipe Run
82	310.00	120		6.10	0.578	130	0.6		0.347		0.35	74.08	73.50	Tee (thru)
83	310.00	120	6.3	6.10	0.578	130		0.005			0.00	74.08	73.50	120" Pipe Run
84	310.00	120		6.10	0.578	130	0.6		0.347		0.35	73.73	73.15	Tee (thru)
85	310.00	120	6.3	6.10	0.578	130		0.005			0.00	73.73	73.15	120" Pipe Run
86	310.00	120		6.10	0.578	130	0.6		0.347		0.35	73.38	72.80	Tee (thru)
87	310.00	120	97.5	6.10	0.578	130		0.070			0.07	73.31	72.73	120" Pipe Run
88	310.00	120		6.10	0.578	130	1.6		0.925		0.93	72.38	71.80	Tee (standard)
89											19.90		71.80	CL of SBA pipe is ?? Ft

Notes:

PPP Hydraulics-2011-03-02.xls

Line #	Flow (mgd)	Diameter (in.)	Length (ft)	Velocity (ft/s)	Velocity Head	C	k (ea)	Friction Loss	Minor Loss (total)		Head Loss (total)	EGL	HGL	Description
												92.28	92.28	Anticipated system pressure of 40 psi CL of SBA pipe is at elevation ?? ft



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APPENDIX H
OPCC for the Full-Barrier Strategy for the SLR System

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SANTA CLARA VALLEY WATER DISTRICT
SCVWD
Invasive Mussel Control Measures at Imported Water Intakes, Full-Barrier Strategy for the SLR System

Opinion of Probable Construction Costs

Currency: USD-United States-MARCH 2011 Dollar

Grand Total Price: $ 30,309,000

Item #	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments/Assumptions
A		**San Luis Reservoir System**	1	LS	$14,012,110	**$14,012,110**	
A.1		**Pacheco Pump Plant**	1	LS	$13,605,210		**$13,605,210**
1	P	Rent Barge	4	Mo	$80,000.00	$320,000	Incl Mod/demob, 500T barge +Tugboat
2	P	Install Pipe Supports at Intake Portal	1	LS	$85,000.00	$85,000	80 crewhr, 2diver+2tender,1rigger, operator+60Tcrane+base support
3	P	Install Pipe Supports along Tunnel and Shaft	1,400	EA	$119.00	$166,600	Concrete ballast collar 5ft spacing, 2 divers+ 2 tender
4	P	Install Containment Pipe - Underwater Pipeline	7,000	LF	$109.00	$763,000	Underwater, 2 diver and 2 tender +pipe crew
5	P	Install Chemical Feed Pipe - Underwater Pipeline 2 lines (one spare)	14,000	LF	$20.00	$280,000	Underwater 2 lines (one spare)- 1" Polyethylene Pipe (inside containment pipe)
6	P	Site Work	1	LS	$100,000.00	$100,000	Allowance for grading, landscaping, fence, erosion control etc
7	P	Install ClO2 Generator	1	EA	$251,000.00	$251,000	Quote ClO2 Generator $236K
8	P	Valve Allowance for Minor Piping	1	LS	$10,000.00	$10,000	
9	S	Construct Chemical Storage Building	4,800	SF	$120.00	$576,000	CMU building
10	P	Install Chemical Tanks	6	EA	$26,000.00	$156,000	FRP 4ea x 10K + 2ea x 13K gal
11	P	Install 4" ClO2 Feed line - Buried	700	LF	$40.00	$28,000	Incl earthwork, 3' min cover
12	P	Filter Unit Foundation and Concrete Pad	300	CY	$400.00	$120,000	120' x 60' x 1'
13	P	Tie in 10' dia for Filter Piping	2	EA	$100,000.00	$200,000	32 crewhr (5men+weld/oxy-ace +crane) +120" Tee x 2ea
14	P	Install Hydac Filter Units - 6-Bar Units	18	EA	$200,000.00	$3,600,000	Quote SS 6-bar each + 160 crewhr (5men+crane)
15	P	Pipes, Valves and Flow Meters (incl Supports) - Connection to Filter Units	18	LS	$93,000.00	$1,674,000	380' x 36"pipe, 450' x 28"pipe, 36eax 28"BFV, 18eax28"Mag Flow Meter+ pipe supports + fittings
16	P	Install 10' dia Piping for Filters	530	LF	$1,800.00	$954,000	Incl earthwork, 4' min cover
17	P	Install 1" dia Chem Feedline, Clarifier Underflow and Screw Press filtrate	300	LF	$20.00	$6,000	incl earthworks and fittings
18	P	Install 4" Backwash	200	LF	$40.00	$8,000	Incl earthwork, 3' min cover
19	P	Install 8" Backwash & Clarifier Overflow	1,860	LF	$96.00	$178,560	Incl earthwork, 3' min cover
20	P	Install Clarifiers and Foundation	3	EA	$296,000.00	$888,000	Quote + 24 crewhr (5men+crane) + 53cy + anchors
21	P	Construct Concrete Vault 15' x 20' x 20'deep	1	LS	$105,000.00	$105,000	15' x 20' x 20'deep incl earthwork and shoring
22	P	Install 120" BF Valves and 12" Outlet Pipe Inside Valve Vault	1	LS	$613,000.00	$613,000	Incl cutting (E) 120" pipe, 2ea-120" BFV and outlet pipe
23	P	Construct Clarifier Underflow Storage Basin	1,288	SF	$150.00	$193,200	28' x 23' x 2ea
24	P	Concrete Foundation, Pad, Bund wall for Screw Press and Storage Tanks	65	CY	$1,000.00	$65,000	30' x22'
25	P	Install Screw Press and Components	2	EA	$474,000.00	$948,000	Quote 85gpm, 6men x 4days + eq installation
26	P	Furnish Open Bed Trailer	2	EA	$50,000.00	$100,000	6ton ea incl truck
27	S	Metering Pump Enclosure	91	SF	$150.00	$13,650	7' x 13' incl earthwork
28	P	Install Metering Pumps	2	EA	$12,000.00	$24,000	Mechanical Actuated Diaphragm Pump ProMinent g/L 1608
29	P	Install Storage Tanks	2	EA	$4,600.00	$9,200	Sodium bisulfite storage tanks for clarifier underflow (4' dia x3'H), Aluminum sulfate storage tanks (5' dia. X 4'H)
30	P	Allowance for Pipe Encasements	200	CY	$400.00	$80,000	incl earthwork
31	S	Electrical and Instrumentation	1	LS	$1,090,000.00	$1,090,000	10%
A.2		**Hollister Bifurcation**	1	LS	$406,900		**$406,900**
1	P	Site Work	1	LS	$25,000.00	$25,000	Allowance for grading, landscaping, fence, erosion control etc
2	S	Metering Pump Enclosure	78	SF	$150.00	$11,700	6' x 13' incl earthwork
3	P	Install Metering Pumps	2	EA	$12,000.00	$24,000	ProMinent Sigma/3 HM 070580 Mechanical Actuated Diaphragm Pump
4	P	Concrete Foundation, Pad and Bundwall for Storage Tanks	100	CY	$1,000.00	$100,000	45' x60' x10"
5	P	Install Storage Tanks	6	EA	$27,000.00	$162,000	Sodium Bisulfite Storage Tank - 7600 gal ea
6	P	Install Chemical Inline Mixer	1	EA	$44,000.00	$44,000	Quote + 1dayx5men + eq installation
7	P	Install 1" dia Chem Feedline	160	LF	$20.00	$3,200	incl earthworks, fittings, 35' U/G piping
8	S	Electrical and Instrumentation	1	LS	$37,000.00	$37,000	10%
S		**Startup/Commission**				**$29,500**	
1	P	Startup Crew	10	dy	$2,950	$29,500	5 man crew + equip
2	S	Vendor Commissioning	1	ls	$0.00	$0	included above
					Running Subtotal:	**$14,040,000**	
T		**Mobilization/Field Oversight Expenses**				**$1,438,728**	
1	P	Contractor General Conditions (Prime)	1	ls	10%	$1,231,326	
2	S	Contractor General Conditions (Subcontractor)	1	ls	12%	$207,402	

MWH
Walnut Creek, CA

ECC
5/18/2011

SANTA CLARA VALLEY WATER DISTRICT
SCVWD
Invasive Mussel Control Measures at Imported Water Intakes, Full-Barrier Strategy for the SLR System

Opinion of Probable Construction Costs

Currency: USD-United States-MARCH 2011 Dollar

Grand Total Price: $ 30,309,000

Item #	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments/Assumptions
U		**Parametric Contingency**				**$1,404,000**	
1	P	Unlisted Items Allowance	1	ls	10.0%	$1,404,000	
					Running Subtotal:	**$16,882,728**	
V		**Markups**				**$3,657,037**	
1	S	Subcontractor Markups	1	ls	15.0%	**$290,363**	H/O Overheads, Job Fee & Risk (Included above), insur, bond
2	P	Prime Contractor OH&P on Subs	1	ls	5.0%	**$111,306**	ditto
3	P	Prime Contractor OH&P on Self-Perform	1	ls	12.5%	**$1,868,573**	ditto
4	P	Contractor Insurance Program	1	ls	2.5%	**$478,824**	Performance/Payments Bonds, Genl Liability, & Bldr's Risk
5	P	State Sales Taxes	1	ls	9.25%	**$907,970**	State excise taxes, tariffs, etc. at 50% of project costs.
6	P	Escalation to MPC	1	ls	2.5%	**$0**	Excluded
					Running Subtotal:	**$20,540,000**	Total Estimated Constr Costs w/o contingency
			MU Factor:	1.217			
W		**Project Administration & Management**				**$9,769,000**	
1	--	Construction Oversight & Mgt	1	ls	7%	**$1,438,000**	
2	--	Inspection	1	ls	3%	**$616,000**	
2	--	Engineering	1	ls	5%	**$1,099,000**	
3	--	Permitting	1	ls	3%	**$616,000**	
4	--	Administration/ Legal support	1	ls	5%	**$1,154,000**	
5	--	Scope Contingency/Market Conditions	1	ls	20%	**$4,846,000**	Design definition/estimating/market allowance
6	--	Owner's Construction Contingency/Mgt Reserve	1	ls	0%	**$0**	Excluded, allowance for changed field conditions
					Grand Total:	**$30,309,000**	Total Estimated Constr Costs w/ Contingency
				Cost Range:	**$20,410,000**	**$48,110,000**	Per AACE cost estimate guidelines
					Total Contingency:	**$1,154,000**	4%

Notes:

1) This OPCC is classified as a Class 5 cost estimate per AACE guidelines. Stated accuracy range = -30% to + 65%
2) Pricing basis = 1st Qtr 2011, escalation to midpoint of construction is not included.
3) P=Prime, S=Subcontractor
4) Prices are inclusive of labor, materials and equipment unless otherwise noted.
5) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
6) Owner soft costs and project management expenses included.
6) Capital spare parts not included.
7) Special Inspections not included.
8) Permit Fees included

OPCC Disclaimer

The client hereby acknowledges that MWH has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that MWH cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from MWH's good faith Class 5 OPCC

AACE International CLASS 5 Cost Estimate – Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 2% to 10% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.(AACE International Recommended Practices and Standards).

APPENDIX I

Reclamation Plan Drawings of Pacheco Inlet Intakes and Trash Racks

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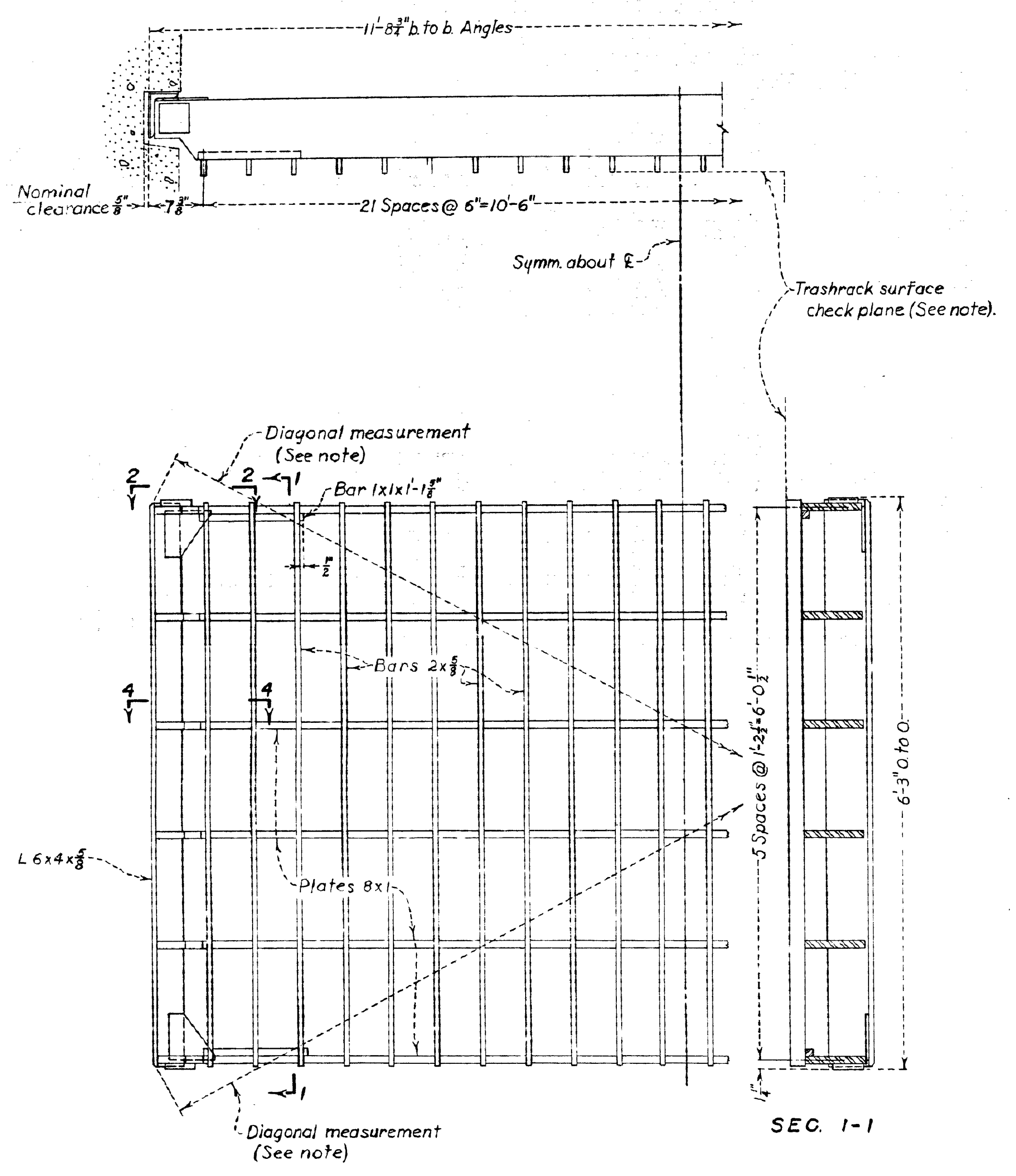
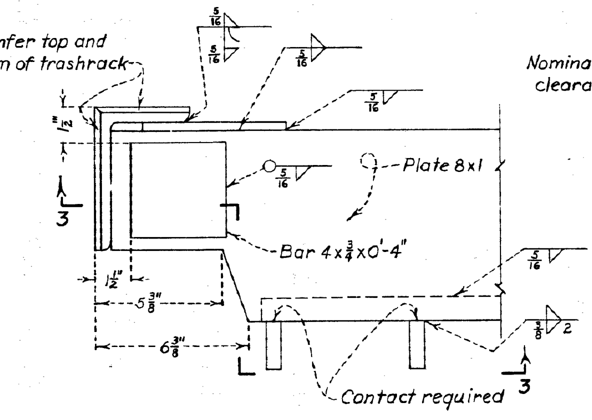
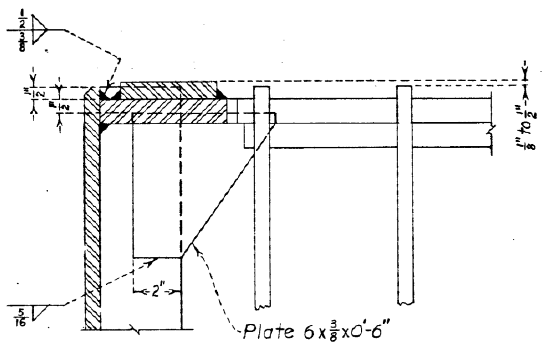

11'-8 3/4" b.to b. Angles
Nominal clearance 5/8"
7 5/8"
21 Spaces @ 6"=10'-6"
Symm. about ℄
Trashrack surface check plane (See note).
Diagonal measurement (See note)
Bar 1x1x1'-1 5/8"
2
4
1
Bars 2x5/8
L 6x4x5/8
Plates 8x1
5 Spaces @ 1'-2 1/4"=6'-0 1/4"
6'-3" o. to o.
Diagonal measurement (See note)
SEC. 1-1

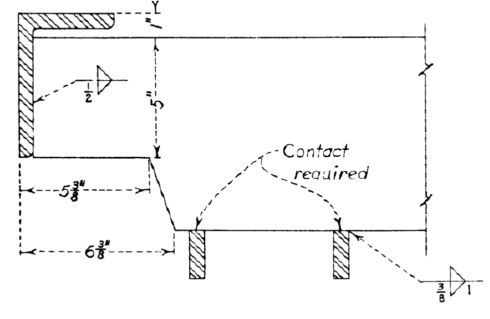
①
TRASHRACK
STEEL
SEVEN REQUIRED
FOR INSTALLATION ON 313 INTAKE (805-D-2513)



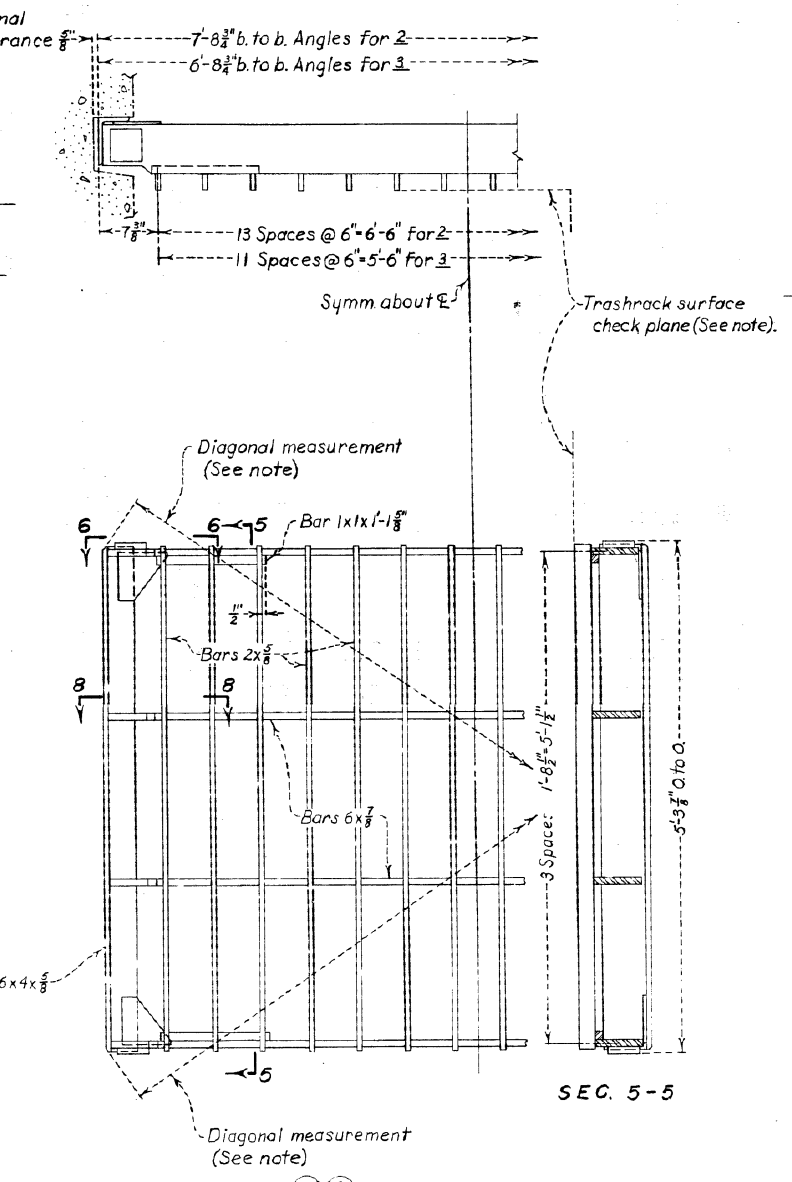
VIEW 2-2



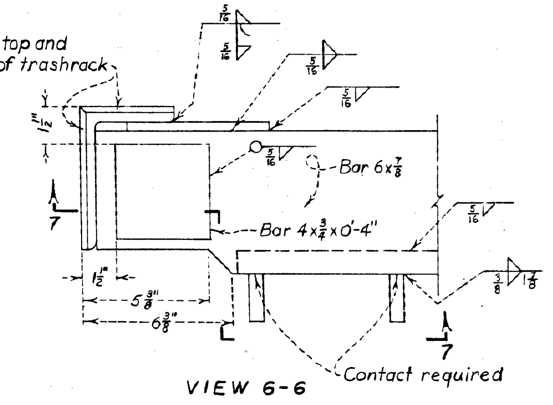
SECTION 3-3



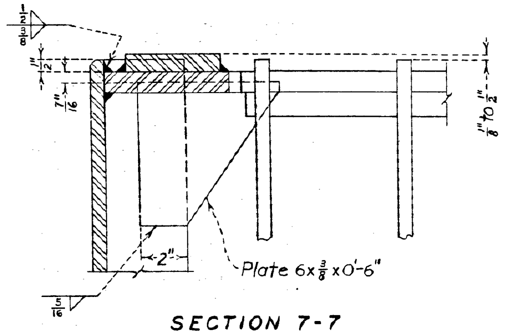
SECTION 4-4


Nominal clearance 5/8"
7'-8 3/4" b. to b. Angles for 2
6'-8 3/4" b. to b. Angles for 3
7 5/8"
13 Spaces @ 6"=6'-6" for 2
11 Spaces @ 6"=5'-6" for 3
Symm. about ℄
Trashrack surface check plane (See note).
Diagonal measurement (See note)
Bar 1x1x1'-1 5/8"
6
5
8
Bars 2x5/8
Bars 6x7/8
L 6x4x5/8
1'-8 1/2"=5'-1 1/2"
3 Spaces
5'-3 7/8" o. to o.
SEC. 5-5
Diagonal measurement (See note)

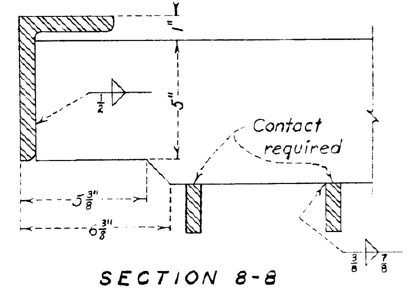
②③
TRASHRACKS
STEEL
2-FOUR REQUIRED AS SHOWN AND NOTED
3-FOUR REQUIRED AS SHOWN AND NOTED
FOR INSTALLATION ON 370 INTAKE (805-D-2514)



VIEW 6-6



SECTION 7-7



SECTION 8-8

REFERENCE DRAWINGS

PACHECO INLET CHANNEL AND TUNNEL TO STA. 198+65.00
313 INTAKE 805-D-2513
370 INTAKE 805-D-2514

NOTES

Welding symbols apply to the joints of all members of similar identification.

3/8" Fillet welds shown 7/8"; 1"; 1 7/8" and 2" long on material of the same dimensions shall be filled completely throughout their lengths, using end stops if necessary.

Trashracks shall be square, with an allowable variation of not more than 1/2" between overall diagonal measurements.

The faces of the trash bars shall lie in the trashrack surface check plane within ± 3/16".

The 6-inch legs of the angles on each side of trashracks shall be parallel, and the 4-inch legs shall lie in a common plane within ± 1/8".

Estimated weight .... 29,000 lbs.

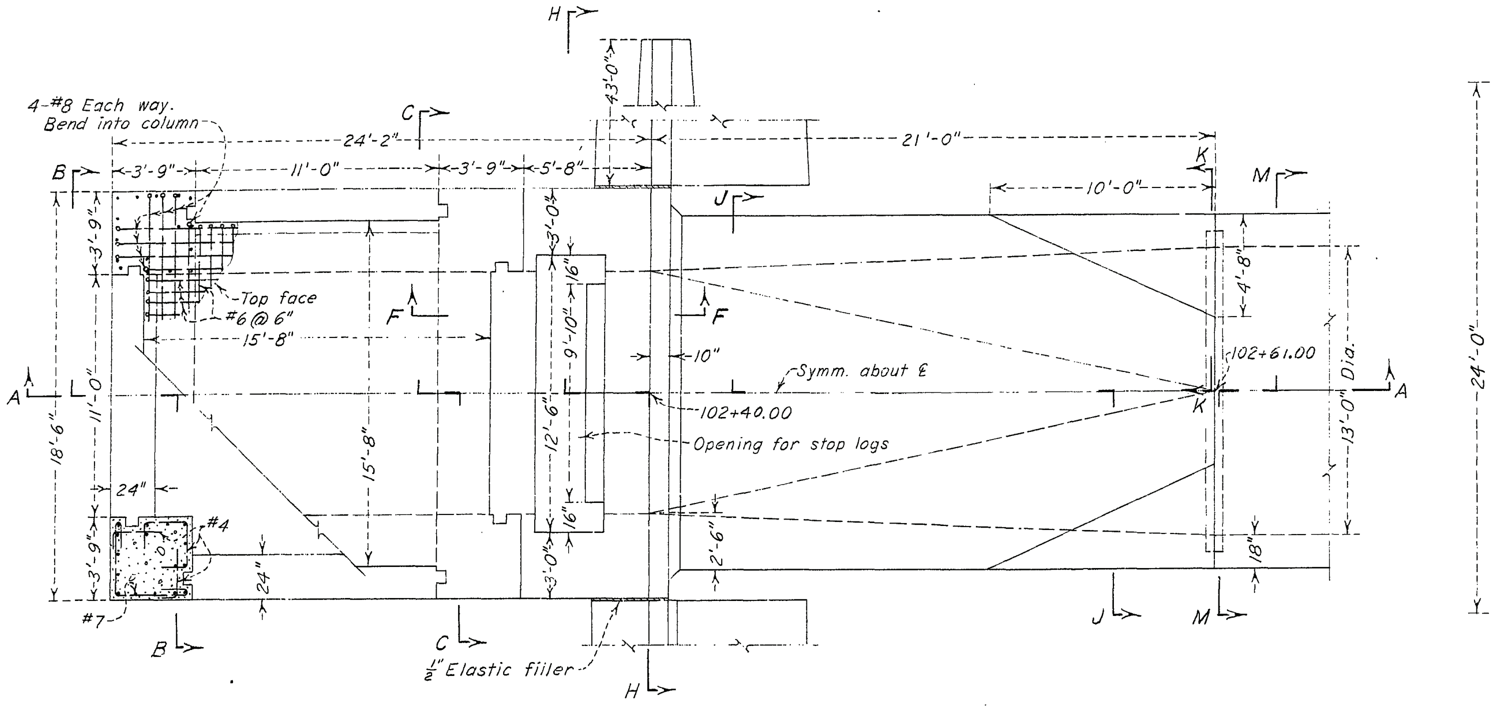
ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
WEST SAN JOAQUIN DIV.-SAN LUIS UNIT--CALIFORNIA

PACHECO INLET CHANNEL AND TUNNEL TO STA. 198 + 65.00
313 AND 370 INTAKE STRUCTURES
TRASHRACKS

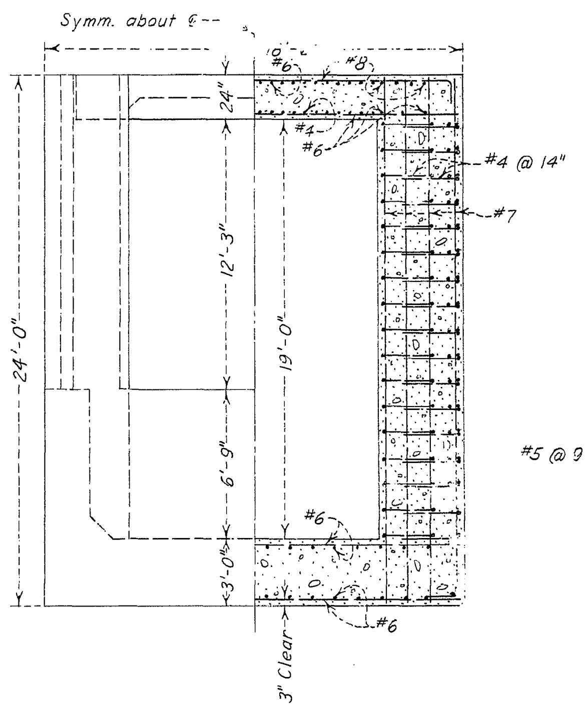
DRAWN R.L.D. SUBMITTED M. L. Barmettler
TRACED RECOMMENDED J. L. Gilbert
CHECKED W.H.T. ALS APPROVED H. E. Sheda
CHIEF, MECHANICAL BRANCH

DENVER, COLORADO, JUNE 26, 1964
805-D-2619

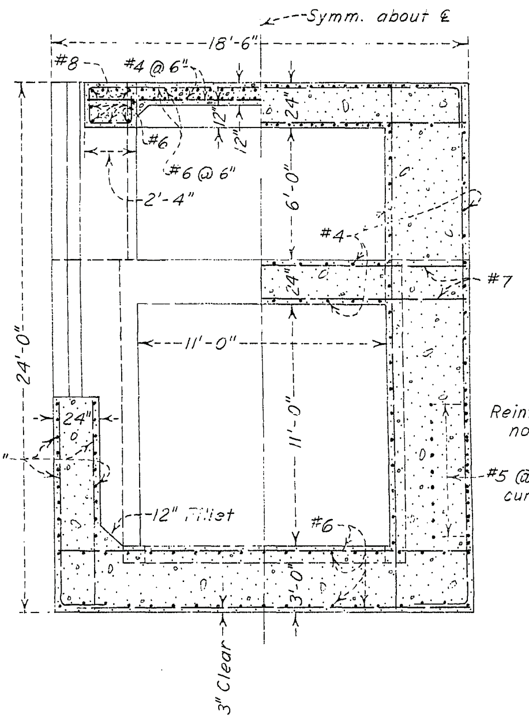


PLAN

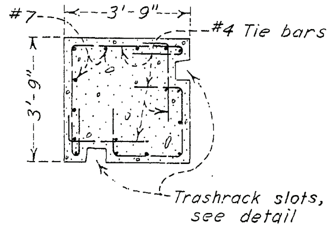
0 5 10 15
SCALE OF FEET



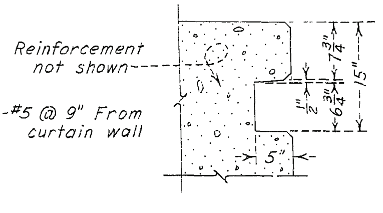
SECTION B-B



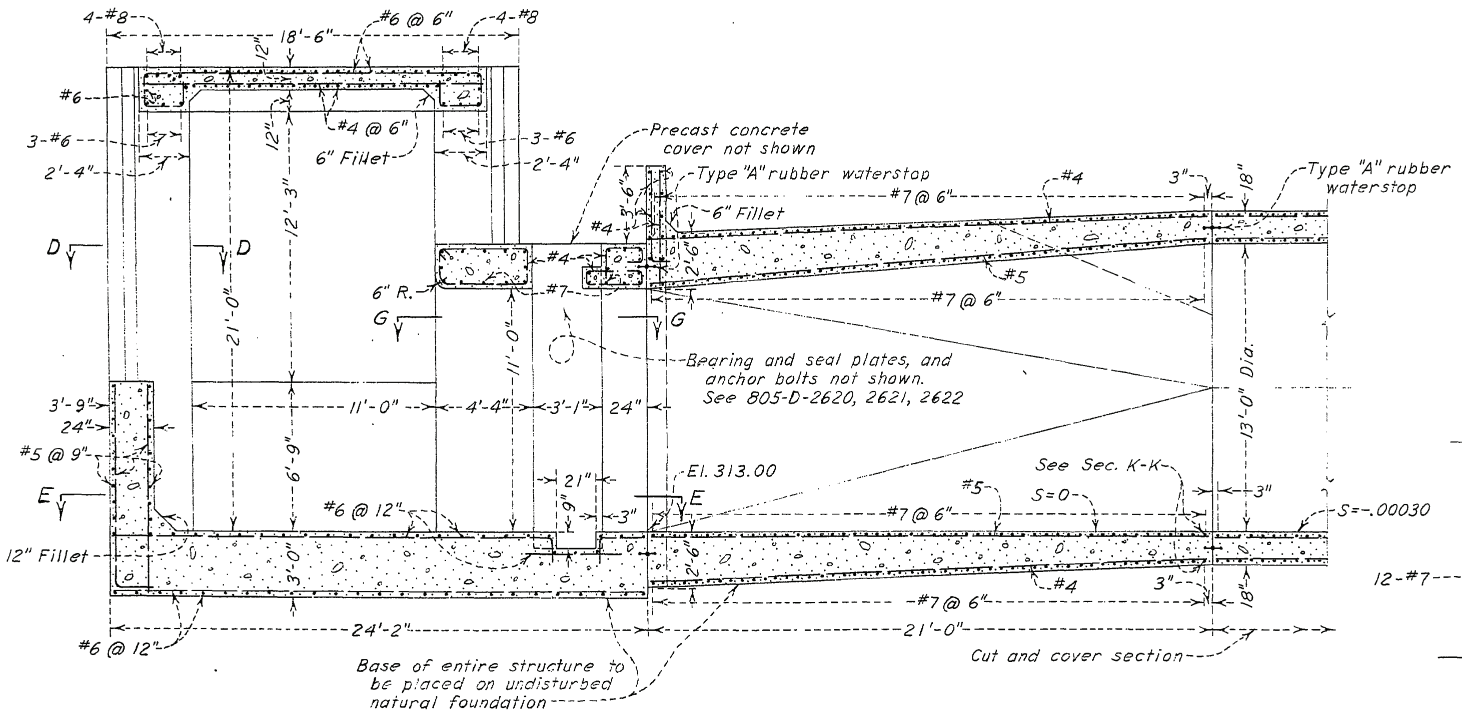
SECTION C-C



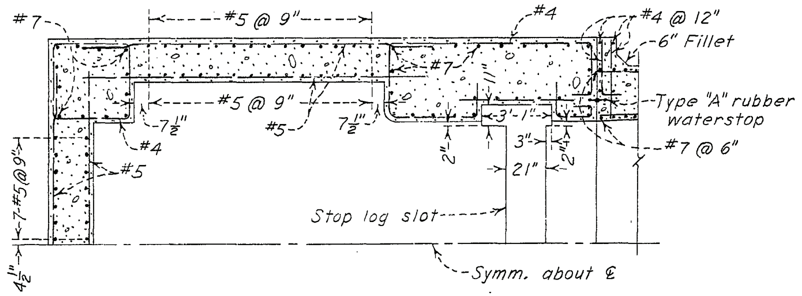
SECTION D-D



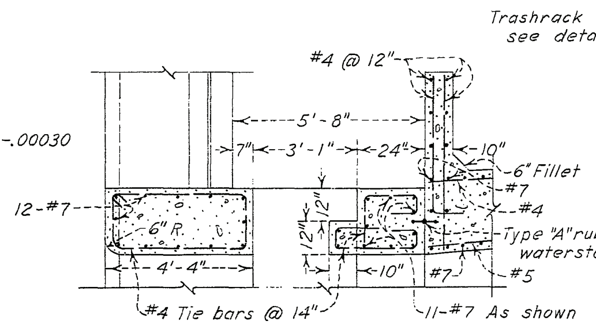
TRASHRACK SLOT DETAIL



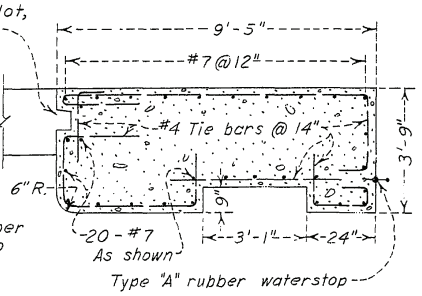
SECTION A-A



SECTION E-E



SECTION F-F



SECTION G-G

0 1 2 3 4 5
SCALE OF FEET

NOTES

Unless otherwise shown, place reinforcement so that the clear distance between face of concrete and nearest reinforcement is 2½". Clear distance for bars marked "tie bars" may be reduced by the diameters of the bars.
Concrete design based on a compressive strength of 3000 pounds per square inch at 28 days.
All exposed edges shall be chamfered ¾" unless otherwise shown.
Lap all bars 24 diameters at splices.
Lifting ring to be AISI type 304 stainless steel.
For alinement and profile see 805-D-2509.
For details of rubber waterstop see 40-D-2867.

8-26-70 D- W.W.	AS BUILT BY 236, LTR. 7-6-70
3-25-66 D W.W.	CHANGED LENGTH OF TRANSITION AND CUT AND COVER SECTION.

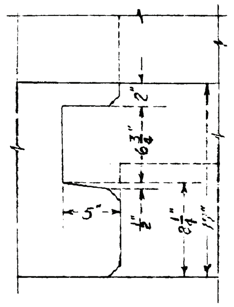
THESE DRAWINGS (805-D-3378 AND 3379)
SUPERSEDE 805-D-2513

ALWAYS THINK **SAFETY**

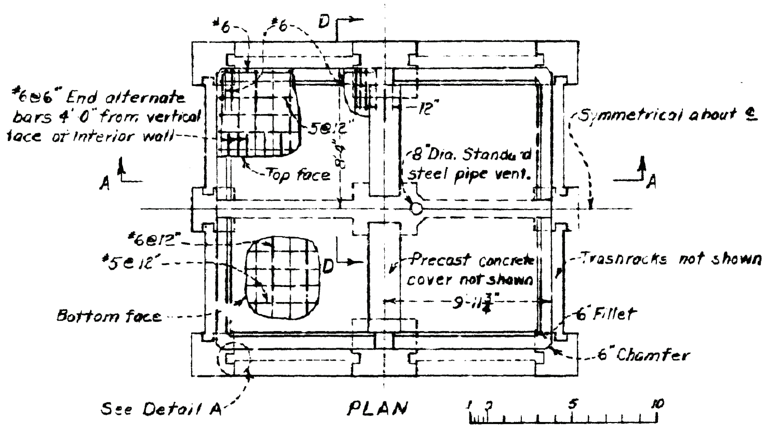
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
WEST SAN JOAQUIN DIV.-SAN LUIS UNIT-CALIFORNIA

PACHECO INLET CHANNEL AND TUNNEL TO STA. 199+17.00
313 INTAKE

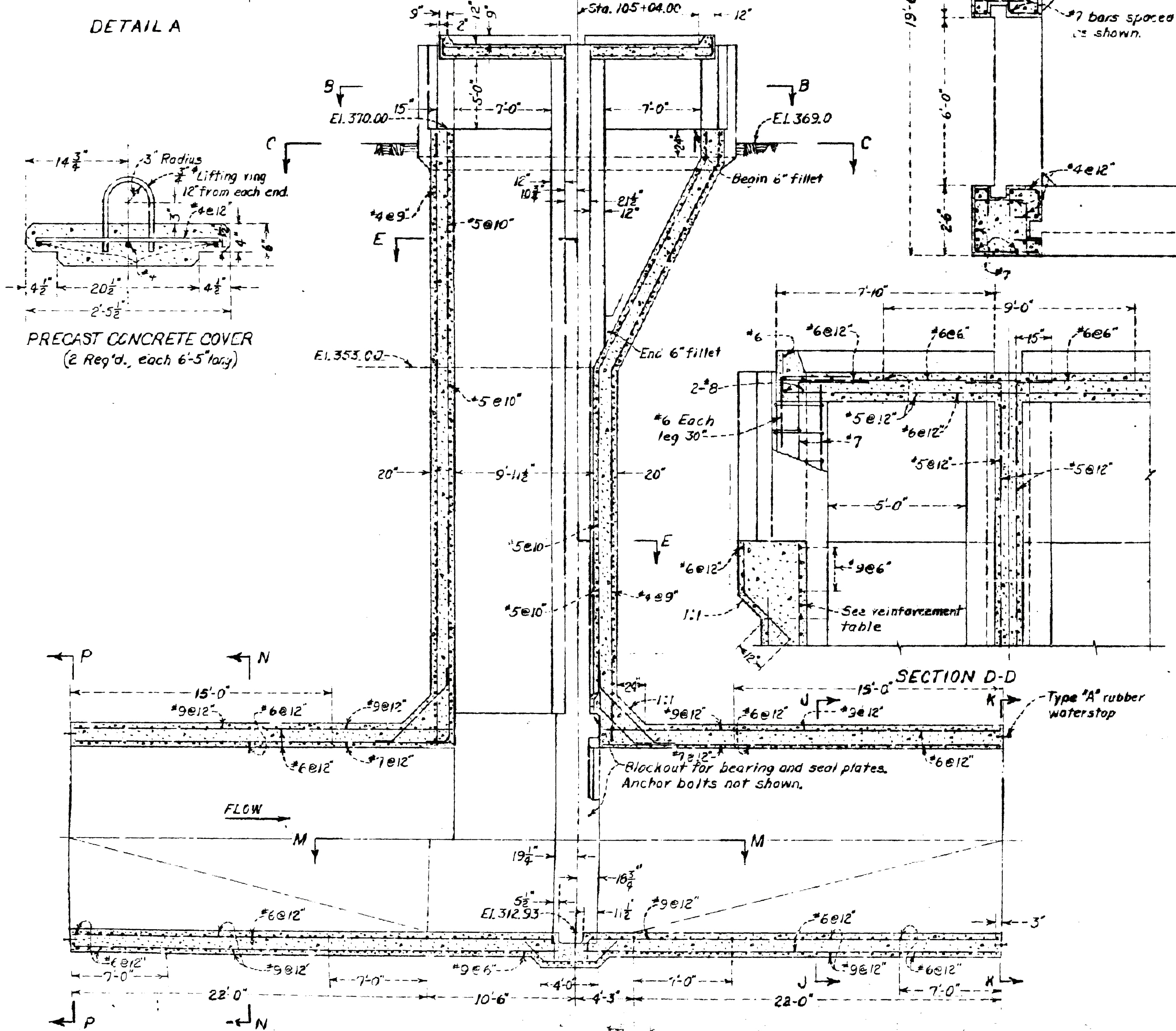
DRAWN F.F.M. SUBMITTED W. F. Schmidt
TRACED RECOMMENDED F. E. Rippon
CHECKED W.W. APPROVED H. G. Arthur
CHIEF DESIGNING ENGINEER
DENVER, COLORADO, APRIL 30, 1965
SHEET 1 OF 2
805-D-3378



DETAIL A



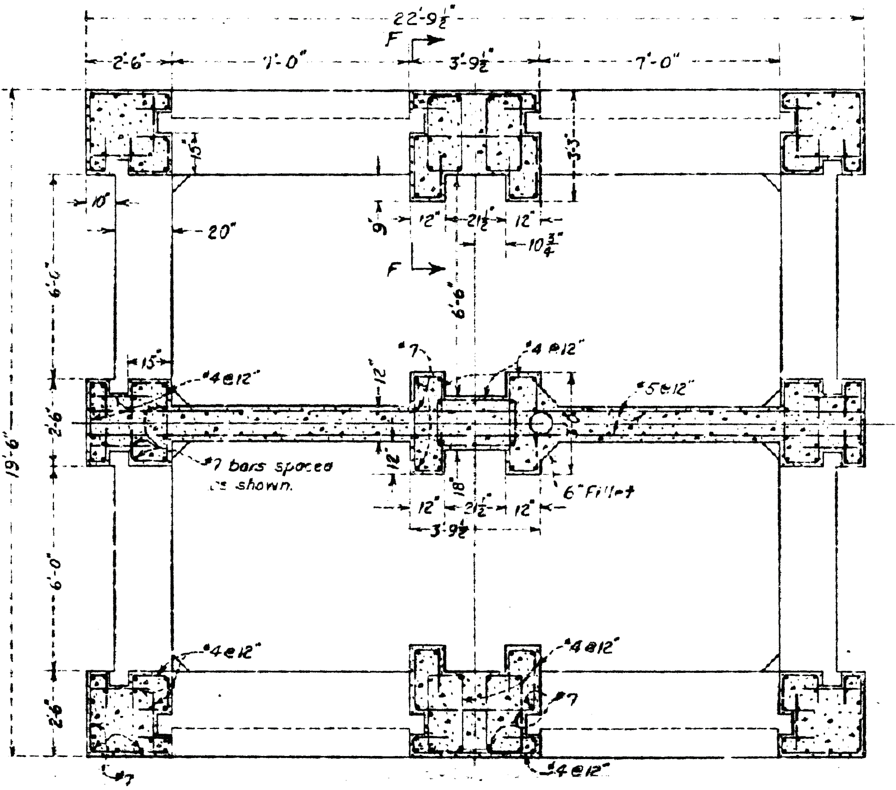
PLAN



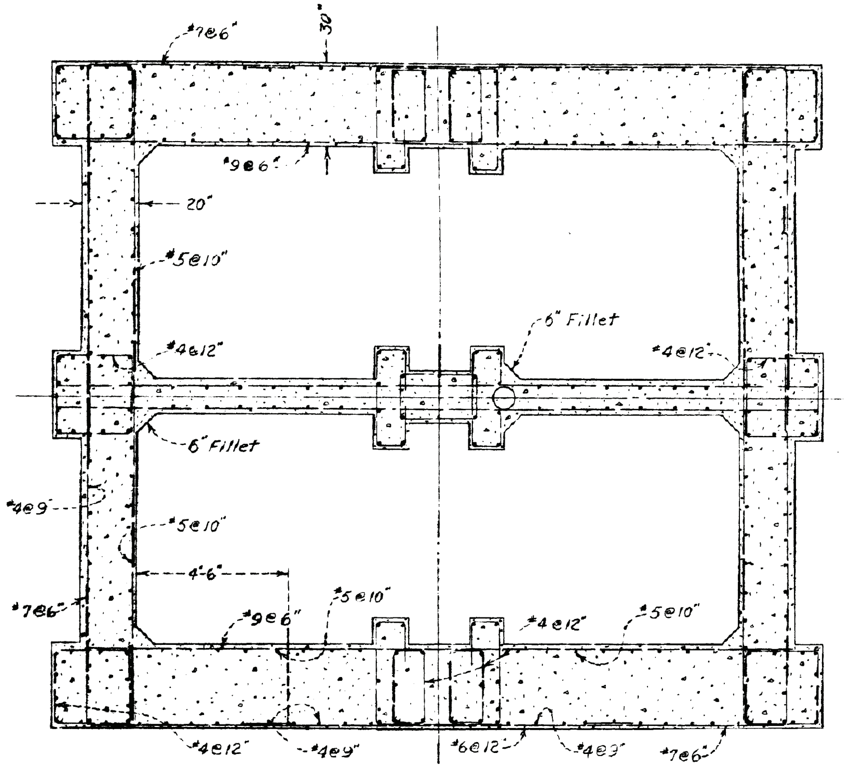
PRECAST CONCRETE COVER
(2 Req'd., each 6'-5" long)

SECTION D-D

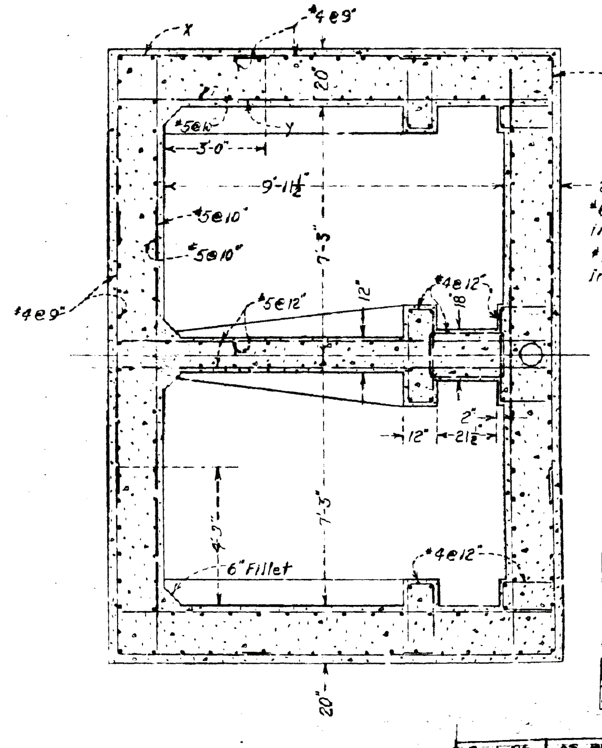
SECTION A-A



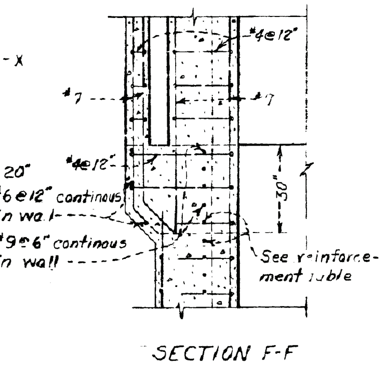
SECTION B-B



SECTION C-C



SECTION E-E



SECTION F-F

NOTES

Concrete design based on a compressive strength of 3000 pounds per square inch at 28 days.

Unless otherwise shown, place reinforcement so that the clear distance between face of concrete and nearest reinforcement is 2" except provide a clear distance of 3 inches from face of concrete placed against earth or rock.

Lap all bars 24 diameters at splices.

Chamfer all exposed edges ¾" unless otherwise shown.

Lifting ring to be AISI Type 304 stainless steel.

REFERENCE DRAWINGS

ALINEMENT AND PROFILE	805-D-2509
TRASHRACKS	805-D-2619
STOPLOG SEATS AND GUIDES	
ANCHOR BOLT SETTING	805-D-2623
AIR VENT	805-D-2507
RUBBER WATERSTOPS	40-D-2867

These drawings (805-D-3380 and 805-D-3381) supersede drawing 805-D-2514.

REINFORCEMENT TABLE

ELEVATION		BAR SIZE AND SPACING	
FROM	TO	X	Y
328.35	336	#8@9"	#6@6"
336.00	345.00	#7@9"	#5@12"
345.00	353.00	#6@9"	#5@12"
353.00	360.00	#6@9"	#5@6"
360.00	368.00	#7@9"	#6@6"

8-1-88 D-[illegible]	AS BUILT BY 246, LTR. 4-11-88 FOR SPECIFICATIONS NO. DC-7530 "NO CHANGES"
3-25-66 D.W.W.	CHANGED LENGTH OF TRANSITIONS

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
WEST SAN JOAQUIN DIVISION-SAN LUIS UNIT-CALIFORNIA

PACHECO INLET CHANNEL AND
TUNNEL TO STA. 198+65.00
370 INTAKE

DRAWN H.J.W. SUBMITTED W. F. Schneider
TRACED RECOMMENDED F. E. Fippen
CHECKED R.B.H. APPROVED H. G. Arthur
CHIEF DESIGNING ENGINEER
DENVER, COLORADO APRIL 30, 1965
SHEET 1 OF 2
805-D-3380

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